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UNITED STATES NAVAL INSTITUTE PROCEEDINGS.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

Honorable Mention, 1912.

INSPECTION DUTY AT NAVY YARDS.

By LIEUT.-COMMANDER T. D. PARKER, U. S. Navy.

Motto: "Ah, make the most of what we yet may spend."

The writer was once much impressed by what he saw at a factory in an old French town: a friend's negotiations for the purchase of the entire output were incontinently stopped by the arrival from the shops of a dozen new-made knives that the manufacturer felt obliged to count and examine at this precise moment. Two points were made clear: (1) the manufacturer was lost in routine; (2) he needed an inspection department.

A modern navy yard commandant, with his imperative military, social, and industrial duties, has little time for counting knives. In these strenuous times, commandants are busy managers—chained to their desks, despatching their callers, clipping their words, dictating, telephoning, writing, writing . . .

Yet the question is asked—and asked too often to be ignored—whether they need organized inspection departments. Is not each foreman an inspector for his own shop? And does not each head of department report on all work under him? Is not a separate inspection department a troublesome and expensive "overhead"? Many such questions are asked. But—much is lost in military transmission. The voice of the "man behind the job" seldom reaches the commandant, who needs assisting ears and eyes, and more direct information than he gets from those responsible for the work they report on. Moreover, it seems to

the writer that the following advantages make the existence of some organized inspection force highly desirable:

1. Certain standards of quality will be maintained only when the workman knows that each piece of work will surely be inspected.

2. Certain abuses as to costs and charges will be prevented when it is known that a force is on the lookout for them.

3. Certain defects of a larger kind will be corrected if a department is free to investigate them.

4. Certain improvements will be suggested by such a department.

The advantage of having a department with the business of doing these things *and with no other and more pressing business* outweighs all objections.

It may be interesting, for comparison, to note the practice of large civilian plants. Of eight such plants, two have a fully organized inspection corps; four have inspectors for limited kinds of work (such as riveting done at piece-work rates), or for coordinating work, or for covering certain contracts; two depend wholly on foremen. But in nearly all cases these plants have resident inspectors to represent their customers and to see that work in progress is being done in a satisfactory manner. That is just what an inspection department does for the one big customer of navy yards.

It is also interesting to compare the inspection methods of a "scientific" system of management like the Taylor system, as developed for civilian plants. Under this system each shop has its own inspector, who is one of the "functional foremen." The personnel devoted to inspection purposes is therefore much larger relatively than that at any of our navy yards. At the New York yard, for example, the total number of assistants and sub-inspectors (at a recent date) was 13; at the Norfolk yard, 7. An inspector for each shop would require about 22 at New York and 16 at Norfolk, without considering those needed for the inspection of stores (especially ordnance material) and of the great volume of outside work. This point is interesting in a comparison of efficiencies under the two systems; for eight or ten men cannot compete with twenty or thirty. It is important to note with care that the field covered by Mr. Taylor's inspectors is much more limited than that of the inspection department as prescribed in General Order No. 53—and their usefulness cor-

respondingly less. The Taylor inspectors check the quality of work in shops. The navy yard inspector (aided by his force) acts as a sort of outside aid for the commandant, observing and reporting general conditions about the shops and yard. He also acts as a coordinator, watches the progress of work, inspects material in store, and performs various other duties as discussed under "Scope of Inspection Duty" below.

These features will be much less important when the commandant has, subject to his orders, an industrial superintendent (compare the "shop superintendents" of divisional heads) to coordinate the work of the manufacturing divisions and to relieve him of detail—as a medical officer does at the hospital, or a marine officer at the barracks. Is it possible for anyone charged with the large administrative and military duties of a commandant to decide on the mass of technical details that *somebody* must pass on? But—"That is another story." At any rate, the inspector is very necessary in the absence of the organizer and coordinator referred to above. When management has been improved as it cannot be under the present system, the need of an inspection department can come up for discussion again.

Meanwhile, even if a modern system of management is to be introduced, something must be done during the period of transition. If the inspector is to go (and nothing above seems to *force* that conclusion), he will certainly be needed until the substitute is offered. The introduction of a modern system requires, from all accounts, a long time—usually three or four years. The development of "functional foremen," including shop inspectors, is a slow process. During this period of unrest, someone must pass on shop work—and the commandant will need, more than ever, an outside aid, "watch dog," and adviser.

SHOULD INSPECTION BE FROM WITHOUT OR FROM WITHIN?

If an inspection department is needed, the next and very important question is:

Should inspection be from without or from within?—should the inspection department be part of the manufacturing department, or separate and distinct?"

In the words of Sir Roger de Coverley, "There is a great deal to be said on both sides." Looking ahead to a time of improved management, no off-hand answer can be given, however one might advocate the separate department at present. Probably

the inspectors would all pronounce in favor of the separate department even with a Vickers system—the "inspected" mostly against it under any conditions. Disinterested officers of ability have differed broadly on this point. The writer, having convictions of his own, finds it difficult to state the case impartially; but he will attempt to outline both sets of arguments. Since the discussion may be trite, it must be brief.

On the one hand the people *who really know most* about a given piece of work are (usually) those who are doing it. Presumably the master pattern-maker or the master ship-fitter knows more about pattern-making or ship-fitting (at least as regards the job in progress) than any one else in the yard. The best inspections could be made by foremen and their assistants, provided they had time and inclination to make them. Moreover, they make some inspections in self-defence; so that other, outside inspection is often a duplication of work. Particularly, inspection from the outside lacks sympathy and understanding, and may partake of the nature of interference. We have all heard of the wise young officer, full of importance and mathematics, fresh from the academy or college, who criticises what he doesn't understand and drives practical men wild. The chief carpenter or boatswain, who is excellent aboard ship but weak in certain details of shop work, may also *seem* a nuisance when, as a rank outsider, he passes on the work of trained mechanics in another department of the yard.

In certain cases these arguments are certainly valid and "must give us pause." Officers who stand strongly for the good of the service advance them with persistence and sincerity.

On the other hand, the purpose and aim of the department when the last "shake up" occurred was to get, at navy yards as at Washington, criticism of work by officers not responsible for it. General Order 53 begins with the significant words:

"Officers performing inspection duty at navy yards are the representatives of the commandant only."

Provided the inspection department has a proper personnel, there are marked advantages in the detached criticism thus obtained. Will not a member of a manufacturing division use soft words when speaking of "our" work to the head of department? Does not a note of admiration creep in when we criticise ourselves? Can the head of a yard department frankly reveal to

the commandant all the defects of his work, organization, and personnel, without sacrificing his own reputation for efficiency? If he can, does he usually feel that he can? And as to the cases where partial responsibility attaches personally to the "man higher up"—will he always own up freely? Or will a discreet inspector serving under him bring such matters before him? It all comes to what has been strongly said and realized during recent years—"Self-inspection is no inspection."

Moreover, great weight must be given to another feature (referred to above) of the present inspection system—*its directness.* When we allow for what is forgotten, for what is misunderstood, for what is intentionally withheld, and for what is tactfully softened—how much that the workman sees and reports reaches the commandant? How very direct is the chain from the workman (or the work) through the sub-inspector and inspector to the commandant, as compared with: workman—leading man—quarterman—foreman—assistant officer—head of department—commandant. "Seven right-angle elbows equal a blank flange."

The commandant who gets all his criticisms from inspectors reporting through foremen and heads of divisions, or from other subordinates who duly follow the usual channels, will enjoy all the security of the "simple little ostrich" with his head in the sand.

One of the civilian plants referred to above—a large and widely known electrical establishment—maintains two inspection forces, both quite independent of the manufacturing body. The employees of one make mechanical inspections and report to a chief inspector whose decisions are seldom over-ruled. The electrical inspectors make final tests and examinations under a superintendent of tests.

CHARACTERISTICS OF AN EFFICIENT INSPECTION DEPARTMENT.

Accepting the inspection department as it is, we pass on to a vital but less controversial topic: What makes inspection work efficient?

(A) *Personnel.*—The first essential is to get the right men. Inspection departments have usually been composed of a commander or lieutenant-commander, sometimes assisted by a lieutenant, with several warrant assistants, several civilian sub-inspectors (or acting sub-inspectors), and a small clerical force.

As to numbers, this force is usually inadequate to the work assigned—which, as before mentioned, is both broad and long. Comparison has already been made with the large force, covering a much more limited field, called for by the Taylor system. Inspections cannot be efficient until this new department is given a larger personnel or narrower duties. Of course we must use "efficient" as a relative term and "cut the garment to suit the cloth." At one of the northern yards the inspection force has consisted of the inspector and two clerks. It would seem reasonable, however, to adopt as a standard the number of assistants suggested by the Taylor system—one for each shop. Each assistant could keep in constant touch with the work of his shop—and those having less work to overlook would have time for the inspection of stores, scanning of surveys, and other duties discussed elsewhere. In the writer's opinion, the inspector with a smaller force than this must make the soothing declaration: "We'll do the best we can."

As to fitness, it is peculiarly necessary that assistants—whether officers or civilians—should be selected men. Although some warrant officers make excellent inspectors, an *indiscriminate* detail of such officers to this duty means failure. As realized by those who have trained "functional foremen," a special type of man is needed for inspections.

> "Others there are
> Who, trimmed in forms and visages of duty,
> Keep yet their hearts attending on themselves"

—and others still who, while excellent at directing work, are indifferent or unwilling as critics. Such persons are *useless* in the inspection department. The man needed has a vague, dull pain when he sees bad work or bad methods; and speaks perforce, even at the sacrifice of his own interests. He must have independence; must prefer efficiency to popularity; and must hate perfunctory shams. Such men can be found. Fortunately civilian sub-inspectors volunteer for the work, and win their appointments by competitive examinations. They also have the advantage (usually) of knowing the yard and the yard personnel. As, moreover, the supply of officers is limited, more civilian sub-inspectors should be appointed. If the inspection department is to be taken seriously in its relation to the hull division, it should surely include a representative of the construction corps. Chief car-

penters do not adequately represent the corps that has been particularly identified with yards and yard work. Would not the detail of a junior construction officer to each inspection department—a step in line with the recent detail of line officers to the hull division—promote a better understanding and decidedly increase the efficiency of the department? The answer seems obvious, unless the inspector is destined always to "make bricks without straw."

Moreover, the close relation between the inspector's work and that of the accounting officer on one hand (as regards charges, costs, etc.) and of the general storekeeper on the other (as regards stores, surveyed material, etc.) makes it desirable that whenever the shortage of pay officers is reduced, a representative of the pay corps should come within the inspector's fold. This need will be more apparent in connection with the discussion of "excessive costs" below.

The medical officer and chaplain may for the present be dispensed with, though questions of hygiene and morals are not wholly beyond the inspector's ken. The civil engineer has inspectors of his own.

(B) *Aims.*—A first impression is that the inspector is detailed as a "yard critic." Better thinking leads to the conclusion that his duties are primarily co-operative. He should be everybody's assistant—not a busy-body, "butting in," consuming time, opposing thought-out plans with hasty ideas of his own, but a patient investigator, an intelligent observer freed from the demands of routine, an aid to the commandant and his departmental heads in pointing out defects and in promoting efforts with which he sympathizes. This attitude will be understood if inspectors will make suggestions to those immediately concerned instead of complaints to higher authority.

Unfortunately they sometimes find it necessary to choose the official channel in order to avoid having legitimate objections or suggestions ignored.

After they have done what they can in a co-operative sense, their critical duties begin. The direct responsibility of the inspector lies here; for, while his other work is largely discretionary, he is required to pass specifically on each job completed, accepting or rejecting it.

It should be noted, however, that the more general duties referred to above are clearly assigned in General Order No. 53

the genesis of the inspection department. Unluckily it is difficult for the inspector to carry out this order, however correct his aims, without seeming to "interfere." Some reserve and tact are obviously necessary, but the only inspector who does not "interfere" *in a helpful way* is the inefficient one whose "good taste" outweighs his sense of duty and respect for orders.

(C) *Scope of Inspection Duty.*—An efficient inspection department must cover the wide field assigned by the above general order. This (as laid down or implied) includes:

(a) Inspection, as to quality, of work in progress or completed.

(b) Criticism of plans for work.

(c) Inspection as to progress of work—with report of delays in starting jobs or of excessive time spent on them.

This feature may be specially helpful to ships.

(d) Inspection of costs—with report of those that are excessive.

(e) Inspection as to shop methods.

(f) By implication—criticism of general yard conditions.

(g) Technical examinations as to condition, etc., of material in store.

For a detailed explanation of the above see "Kinds of Inspection."

Added to this at most yards have been the general supervision of survey work and scanning of survey reports. Though the point is disputed, this seems to the writer proper work for the inspector and closely related to his other duties—*provided his force is correspondingly increased.* It may be disastrous to diffuse the energies of the present inspection personnel. A distinction must be made, however, between the supervision and scanning of surveys, and the actual surveying, which is done by officers detailed from the various departments.

It was also suggested at the conference of commandants that the inspection department should inspect stores purchased for the general storekeeper. A majority voted against this; and such inspections are usually made by the divisions concerned. Although it might be logical to include this in the work of the inspection department, these inspections are wholly different from those for which the department was created, and the present size of the force does not permit this extension of its duties.

(D) *Methods of Inspection.*—The inspector should keep general track of shop and ship work, singling out the larger jobs

for personal observation; and should inspect personally when questions arise between representatives of the manufacturing department on one hand and his assistants, or officers of the ships, on the other. He should be the "assistant chief umpire" for the commandant. He is also the centralizer, digester, and forwarder for his department.

It seems obvious that he should spend at least half his time in the yard and shops; yet for reasons given at length below, it is difficult for him to do even that. Conferences with assistants, interviews with officers of other departments, memoranda, reports, signatures, surveys, bind him to a desk with the same Lilliputian cords that so many others have vainly struggled against. The inspector *must*, however, get a first-hand knowledge of jobs, and should do all in his power to minimize office work. It is hoped that the centralization of offices and of filing systems will help much in this respect. His assistants should be impressed with the fact that *their* work is wholly (or almost wholly) outside. Each should spend seven hours a day in and about the shops.

The distribution of inspection duties should be along the lines of individual fitness. An average inspection force may include a lieutenant, a chief gunner, a chief carpenter, a boatswain, a machinist, and, say, three sub-inspectors, one from the hull division and two from the machinery division.

The lieutenant should have some special assignment (in line with his aptitudes), should have certain authority as a general co-ordinator and assistant; and should be trained to act in the absence of the inspector. Here it may be noted that it does not seem desirable to have the reports of the other assistants go through him, for that throws in just so many ohms to resist the current of information.

The chief gunner, under the inspection officer, would take over many duties of the former ordnance officer. He would spend fully half his time in the ordnance building, directing the work of the general storekeeper's ordnance force, inspecting material, suggesting work needed for its preservation, selecting articles for survey, and probably acting as survey officer for ordnance stores. His technical advice is of value to the general storekeeper and the manufacturing heads. He may also, if qualified, take over electrical inspections, in whole or part, this depending upon what other assistant is available.

The chief carpenter and one sub-inspector would divide most of the hull work between them. In this division of labor the question of individual fitness is important. One plan has been to give the first of these assistants all shop work, the other all ship work; but though this is convenient as a time-saving arrangement, it ignores the principle just referred to. The sub-inspector assigned to ship work may not have a sea-going knowledge of flushing systems, fire mains, drains, etc. The chief carpenter may never have worked in a shop from which the sub-inspector was appointed. It is better to find out the classes of work that each knows most about, and assign jobs without undue regard to location. The use of bicycles will shorten distances immensely, so that an assistant can inspect a ship-fitting job on a ship out of commission and two minutes later go through the blacksmith shop.

The boatswain, though less needed than the others, would have the sail loft, the shipwright's shop, and the rigging loft. He would have additional duties as survey officer for his department.

The machinist and a sub-inspector appointed from the machinery division would divide machinery inspections in the same way that the two assistants referred to above divide hull-division work.

The third sub-inspector, if qualified, would take over all electrical inspections. He should be specially appointed for this duty.

It seems desirable, in some cases, to have two assistants inspect the same piece of work, and each "O. K." the job order. For instance, an anchor engine should be inspected by both carpenter and machinist—each from his own point of view. A fire main might be inspected first by a sub-inspector for mechanical defects; secondly by the carpenter for the suitability of leads from the man-o'-war's-man's standpoint.

It should be borne in mind that the above assignments are suggested with a view to inspection departments as they are, not as (it is thought) they should be.

Each assistant should have an eye to cost, as well as to quality, of output. While keeping track of work in progress, he should note whether it is being done in the right shop, whether the right machine is being used, whether first-class men are engaged on helpers' jobs, whether two gangs are needlessly working at the same job, whether over-expensive material is being used, etc.

The plan has been tried of having an assistant specially detailed for cost investigations. If this is done, he should work in conjunction with the others, who, during their daily rounds, can note faults as indicated above for the special assistant to investigate in detail. With an ideal personnel, the system of having each make his own cost studies might be preferable; but with existing conditions it seems better to have a specialist develop methods, study accounts, and concentrate on this kind of duty, which involves clerical work and lengthy inquiries that would consume too much time of a man whose aptitudes lie differently.

At one yard a sub-inspector was assigned to time and efficiency studies based on modern methods of management.

(E) *Accuracy and Discretion.*—Whatever methods be followed, any criticism—good or bad—of the work of the divisions is likely to be an annoyance to the officers concerned. However broad a busy man may be, he will probably feel nettled at a criticism of his subordinates or a suggestion from an outsider as to improvements in the department *he* is straining to improve. Such suggestions come when he is deep in other matters, and require at best a mental twist. Irritation results if the criticism seems trivial or ill-founded. Therefore the first duty of the inspector is to avoid hasty action through excess of zeal. Unless he wants to be shaken off as a nuisance, he must be tactful, restrained, and judicious. ***He must insist on absolute accuracy in himself and from his assistants.*** No report should be forwarded until study and discussion have proved the point to be well taken. A slip, even in a small detail, unduly discredits his department, with divisional heads already (perhaps sub-consciously) prejudiced against outside advice, or with commandants who, in the struggle with routine, have scant time to pick truth out of a mass of conflicting endorsements. Let the length of a screw or the name of a nipple be obscurely misstated, and the return endorsement will begin with a prominent "The inspection officer is in error, etc.," that catches the eye of the common superior. Many big truths are killed by small errors. An effective critic should spend hours in studying a case in order to spend minutes in tersely reporting it. Moreover, as commandants and others are so pressed for time, he should select the cases—choosing those that are typical rather than sporadic, so that his report may result in something.

(F) *Subordination of Paper Work.*—Though many reports can be made in person or by telephone, some must be written as a matter of record or for convenient reference. Otherwise, every effort should be made to minimize paper work. The importance of this has been referred to above. The efficiency of the department depends largely upon whether paper is a means to an end, or a perfunctory substitute for something real.

A considerable amount of paper work is unavoidable with the present system as outlined in General Order No. 53. At a large yard a force of three or four clerks—say a chief clerk, a stenographer, a typewriter, and a messenger—are kept pretty constantly busy, especially if they handle surveys. This will be understood if we consider the usual and necessary procedure in the handling of job orders and records. When a job order is issued, duplicate copies are furnished the inspector. One of these goes to the assistant concerned, the other is kept with a record of all matters relating to the inspection. Report is made in writing (sometimes in advance by telephone) when the job is begun and when completed. The report of completion may be made by the foreman's forwarding a *third* copy of the job order with notation to this effect. The assistant inspects the work, and immediately turns in his copy with notes as to acceptance or rejection (with cause), and other matters of interest. The gist of these notes is transcribed on the retained copy and a copy of the notes furnished the accounting officer as authority for closing accounts on the satisfactory jobs.

Other details as to the handling of these papers would be tiresome, and are omitted. It can be seen, however, that with thousands of job orders passing in and out, the clerical work involved is heavy; moreover, if proper records are to be kept, it is hard to say how the work could be much lessened. Probably in time somebody will think of a way.

There is much other necessary clerical work: the filing of job orders, transcribing of letters and memoranda from the inspector, writing of endorsements, correction of errors in the transmission of job orders, answering telephone calls, handling of surveys, and numerous time-consuming details. The handling of copied correspondence is referred to below. Even under intelligent supervision, the force referred to above will be kept constantly busy.

If inspections are to be made understandingly, the office should receive copies of all yard correspondence affecting its work. This correspondence must pass over the inspector's desk and be distributed for the information of the various assistants. No attempt should be made to retain it permanently in a separate inspection office file. Although this handling of copies requires more clerical work, it is highly necessary; for the inspector cannot pass properly on work unless he has seen certain correspondence about it—and mere access to such correspondence helps him little, since he does not know of its existence. Copies should be furnished, looked over, and destroyed. This is in no way inconsistent with the principle of a central filing system. The routing of originals through this office would entail too much delay.

Since such clerical work is necessary, the main thing is that it be done by *clerks*, and as little as possible by the inspection force. As emphatically stated above, a paper inspection department might as well exist on paper only.

Much time is lost by assistants in getting the "O. K." of ship's officers to work done on ships and inspected by these officers as well as by the yard force. This would not be so bad if it were not desirable to make report of inspection *immediately after completion* in order to expedite the making out of invoices. Much hunting and waiting for the ship's officers results. An efficient assistant once told the writer that he spent nearly half his time getting ship's job orders signed up! Of course, this can and should be remedied. Mailing these orders for signature is usually satisfactory, except that it involves delay. The above statement illustrates, however, the danger of clerical non-essentials eating out the heart of inspection work.

(G) *Weekly Conferences.*—A weekly conference of the inspection officer, his assistants, and the chief clerk, with the latter as recorder, gives a fine opportunity for the discussion of general matters.

KINDS OF INSPECTION.

The various kinds of inspection have been enumerated under "Characteristics of an Efficient Inspection Department" above. It is necessary to explain briefly what is meant by each.

1. *Inspections for Quality.*—This is what the inspector is chiefly responsible for. It is his duty to see that these inspections are thoroughly made, and his misdemeanor (in a military sense)

if any defective job is passed. He should secure expert mechanics for his assistants—or lacking these, should do all he can to train the personnel at hand. Carelessness in passing over mechanical defects should be the unforgivable sin. The method of inspection and its closeness must depend upon the extent of ground covered by the assistant. In any case he must check up the work closely enough to feel morally sure that it will serve the purpose in hand. Essential measurements should be checked; pressure tests should be witnessed; castings should be closely examined for blow holes and given an air test when practicable. From heaps of similar articles such as hinges, samples should be taken at random and carefully examined. Comparison should be made with drawings, and work checked for completeness. Forgings should be examined for defective welds. Electrical circuits should be tested; voice tubes talked through; engines tried under steam. In general, it is for the assistant to explain if he affixes his stamp to any piece of work that is not what the job order calls for.

The effect is to make workmen much more careful. It has been said truly that an inspection body is like a police force that makes few arrests but "keeps the lid on." Bad navy yard workmanship isn't common nowadays. The complaints are rather as to over-elaboration, excessive cost, delays, etc.

2. *Plans.*—The study of plans is an important duty of the inspection department—and is sometimes slighted. Each assistant should make routine visits—weekly or preferably daily—to the draughting room, and arrange for the chief draughtsman to have ready new drawings, details of work in progress, etc. The inspector should discuss important undeveloped plans with the draughtsmen and officers who are working on them, and should make timely criticism of defects. Some good has been effected in this way; but a ship seldom leaves the yard after a fitting out or a general overhauling without defects and oversights that inspectors might have noted before a nail was driven or a hole tapped.

When all plans are supervised by *sea-going* officers (whatever their corps), the number of such cases will be fewer.

3. *Prevention of Delays.*—Without any direct authority to regulate the order of work, the inspection department, through reports to the commandant and others, can be a great help to ships by seeing:

(a) That work is begun with all reasonable promptness.

(b) That steps are taken to expedite the delivery of specially needed material.

(c) That towards the end of a vessel's stay jobs are being pushed to completion.

Ship's officers, though best qualified to pass on work when done, are not sufficiently familiar with the methods and personnel of navy yards to push it. They lack facilities for finding out the cause of delays, and information as to the best man to see in each case. Here the inspection people, with their knowledge of the yard and the other work in progress (from which men may perhaps be shifted or material substituted), may co-operate very helpfully.

When a ship arrives for a stay, the inspector should quickly get in touch with her officers to find what is the status of her unfinished jobs and what work is particularly wanted. He should then, after due consideration, report delays in starting work. He also keeps touch with jobs in progress, and notes obstructions due to non-delivery of material or to non-completion of incidental work by another department. If the wait is for material, he takes the matter up with the divisional officers and the general storekeeper. He finds perhaps that the request to the latter was not made as "urgent," or that the general storekeeper has failed to investigate delays in delivery, or that routine instead of emergency methods of purchase have been followed. In any case he can often suggest action (such as the sending of a telegram) that will promptly remedy the trouble. With a scientific system there would be few such delays, and these few would be automatically noted; but at present they often occur. If the trouble is in a wait for incidental work, a report to the divisional heads may result in the necessary action—perhaps overtime or shift work instead of a leisurely eight-hour swing.

At a routine time, towards the end of a vessel's stay, the inspector should call on each assistant for a detailed statement as to the progress of his jobs, and after sufficient investigation should forward these reports in such shape that the commandant or others will see exactly what remedies to apply—overtime on a certain job in the boiler shop, a telegraphic request for conduit, etc. If needed mechanics are employed on less urgent work, specific report should be made. A vague intimation that "the

Oklahoma's repairs may not be finished up," or that "the *Oklahoma's* bridge work is running behind" is of little practical value.

Take a typical case. The "*Alaska*" is to leave the yard in fourteen working days. The inspector orders all her jobs checked up, and receives word that her turret work is behind the schedule. On investigation he finds that the electricians will need six days for their work and cannot do it until the ship-fitters have secured a certain tube in place and the pipe-fitters have run certain conduit; also that some needed wire due ten days ago has not arrived. It turns out further that the ship-fitters are waiting for some angle irons from the blacksmith shop, and that the blacksmith and ship-fitters are both short-handed.

He reports these facts to the commandant, and recommends (after further consultation):

1. That two blacksmiths working on a job for *stock* be put on the angle irons to finish these quickly.

2. That four additional ship-fitters be called (only four are registered), and that overtime work be done to expedite the securing of the tube.

3. That electricians assist pipe-fitters in running conduit.

4. That a telegram be sent requesting immediate delivery of wire—and that if it is still lacking, some *reserved* (but not yet needed) *for the Kearsarge* be used.

While some of these steps might have been taken without the inspector's suggestion, it is unlikely that all would have been. The ship's officers, though uneasy, have not known exactly what to do. The divisional officers and general storekeeper have had various other jobs to think about. The result is, that after a scramble, the last cable is pulled two hours before the *Alaska* sails!

4. *Reports of Excessive Cost.*—The inspector is required to note and report cases of "excessive cost." As already said, these cases may be investigated in two ways—by assistants separately, or by a special investigator acting in conjunction with the others. The subject is a wide one, and can only be outlined here.

A man up a tree might suppose that the accounting officer makes a study of costs. But he doesn't (to any extent) *as yet*. He merely *records* charges that, lacking technical information, he cannot criticise. It is hoped that eventually a system of real cost keeping will be developed for the benefit of the manufacturing

officers. *They,* moreover, occasionally investigate overcharges, and make constant efforts to prevent them. But they are busy *getting work done when needed;* and cannot give the subject the attention it deserves. It therefore devolves upon the inspector to stop the gap and to systematically point out cases of extravagance. With his present force he cannot analyze all charges; but, following the "method of exceptions," he can closely investigate typical overcharges. With the active support of the commandant and the divisional heads, he can thus do much towards increasing yard economy. It would be useless to cite instances showing how much room for improvement there still is.

The nature of these investigations (some of which have been already referred to) may be indicated by the following statement of subjects for cost criticism:

(a) Charging work done on one job to another job. This was formerly a common abuse. Two evils result from it—unauthorized work; and authorized work charged for excessively.

(b) Charging general shop work to specific jobs arbitrarily selected. This is a misleading way of artificially reducing the "overhead."

(c) Disparity between estimated and actual costs. In the present state of estimating this is unimportant; but with an improved system, estimates and costs would mutually check in a valuable way.

(d) Manufacture where purchase would be cheaper (or the reverse). Many cases can be pointed out where purchase should be substituted for manufacture at excessive cost. Occasionally the reverse obtains.

(e) Excessive cost of manufacture as compared with that at (1) other yards, (2) commercial establishments.

(f) Uneconomical shop methods.

(g) Use of wrong class of labor. Sometimes the cost of work is greatly increased by the use of first-class mechanics where helpers would do. Each case has to be studied on its own merits.

(h) Use of too many men. Sometimes two gangs are employed, each in the other's way—or superfluous labor is otherwise used. This may at times be due to the habit of "nursing" jobs caused by our system of labor employment.

(i) Hand work where machine work would be much quicker and cheaper. This may be due to the wish of a foreman to keep work in his own shop.

(j) Use of wrong machine. Loss of economy often results in the same way from the foreman's preferring an unsuitable machine in his shop to a suitable one in another.

(k) Over-elaboration in doing work—or use of too costly material. Work often costs excessively merely because it is too good for the job in hand.

(l) Material drawn for one job (and not needed) used on another. This kills cost accounting, and makes the charge against the first job excessive.

(m) Waste of material. Some of the largest gains claimed in connection with the introduction of "modern management" at the Watertown Arsenal have been in connection with eliminating waste of material.

At two or three of our Eastern yards, frequent cost reports have been made by the inspection department. Although authorities differ as to the proper scope of such inspection duty (one view being that cost study is properly a function of the *manufacturer* aided by the accountant), it is undoubtedly true that the inspector is now charged with it by the department's general order; that no other department now goes at it "hammer and tongs"; and that much alarm has been caused by the cost studies already made. The inspection force has at least served the moral purpose of a "Fleet in Being."

5. *Shop Methods.*—The question of shop methods is woven in with that of costs. This kind of inspection can be made clear by an example.

It was found at a certain yard that when machinery was finished the foreman would issue a shop order on the joiner, "Crate one set of crank brasses," "Make box for one gasoline engine," etc. Investigation disclosed the following facts:

Directions were so vague that the joiner often made expensive boxes where cheap ones would answer.

These expensive boxes were sometimes made when no box was needed—when the material was to travel only a few hundred yards.

New (even finished) planking was used when old packing material was plentiful.

The searchlight was turned on; and these methods were (it is hoped) made obsolete.

As divisional heads are sensitive about shop methods, inspectors should be particularly sure of their facts before suggesting improvements.

6. *Yard Conditions.*—It seems within the spirit, if not the letter, of the oft-quoted General Order No. 53, that the inspector should report on general yard conditions—for instance, an accumulation of old material; a bad arrangement of storehouses; the blocking of a roadway. In many such cases, of course, his report would be made to, or through, the captain of the yard.

7. *Inspection of Stock.*—When the general storekeeper took over all stock, the various departments, still having cognizance of it, advised him as to its care; later, under the Newberry system, the various departmental inspectors did this; now, combining faded glories, the inspection officer makes technical examination of the stock *in all departments.* This is an important duty—for the general storekeeper must rely on him for expert criticism. A routine of weekly and quarterly inspections of stock should be established; and report made of such things as, spruce poles languishing for fresh water; rubber spoiling from too much heat and light; machinery deteriorating for want of white lead and tallow or in need of a jacking over; electrical insulation yielding to moisture. Special attention should be given to surveyed material (see below).

8. *Duties in Connection with Surveys.*—To complete the inspector's honors and titles, he might be called the "Director of Surveys." The handling of surveys should certainly be centralized. The commandant cannot scan them all; his aid has other duties. A clerk can be assigned to the duty of scanning them—in a clerical way. But until the inspector was given this added duty, no one did much more than return reports "for correaction in accordance with Article ———, Navy Regulations"; or request that ensigns be "burned," not "stored"; or sternly demand that "no responsibility," etc., be duly inserted. Technical scanning was practically unknown. If a surveying officer, by mistake or through carelessness, recommended that a new piece of furniture be sold, or that spare parts accidentally separated from the mother machine be scrapped, his mistakes were liable to pass unchallenged.

Some idea of the importance of the survey question may be obtained from the following figures, selected almost at random,

showing the magnitude of survey transactions at a large yard during one quarter (April-June, 1911). The figures are official:

Invoice value of surveyed articles on hand at beginning	588,151.75
Invoice value of surveyed articles received.....	370,434.28
Total	958,586.03
Expended	606,601.24

Where the annual transactions run into millions, it is worth while to have a system of checks.

The following steps tending to the proper handling of surveys should be taken:

(a) Each survey should be looked over, first, by the proper assistant; secondly, by the inspector in person. Reports should be returned for both minor and major corrections. If important changes are then made, the matter should be taken up with the commandant.

(b) A series of memorandum instructions should be issued and copies furnished each surveying officer with a view to standardizing methods of survey.

(c) The inspector should be in touch with the general storekeeper and with the surveying officers regarding all survey matters.

(d) There should be a weekly conference of the inspector with his surveying assistants, who (while usually assigned to other duties) are under his general direction as regards this duty. Such conferences have proved interesting and instructive.

PERSONAL DUTIES OF THE INSPECTOR.

General Duties.—The day's work for the inspector has already been described under another heading. Without repeating, it may be interesting to discuss some special aspects of his duty.

(A) *The Inspector as a Promoter.*—Although the word "promoter" suggests Blackie Daw and his friend Wallingford, it is not used unkindly here. The thoughts of a well-meaning critic turn to remedies. Having discovered these, he may even *urge* them. When the inspector reports a faulty condition, the first and sometimes disconcerting question is: "What do you want to do about it?" After all, the critic who can't answer this question is merely destructive. By a natural extension of his regular duties, the inspector is therefore called on to "find a way." Having proposed a plan, he wishes to see it work, and begins to "push."

Indeed, if any navy yard officer wishes to be effective, he must do much more than suggest. He must drive his points home; follow papers through; secure consideration of his ideas under difficulties. The momentum of the big yard machine makes a gentle suggestion like a twig in the path of a motor car. The inspector-promotor labors under the disadvantage of always having to lug in new business not on the regular calendar. On the other hand, he has ready access to the commandant, and can get approval of his ideas if they are good and if he is persistent. But this isn't all. It is a pipe dream to suppose that "Approved" on a letter or endorsement means "In effect." Orders given in this form are misunderstood, mislaid, forgotten. The inspector must explain, hunt up, remind. His work is only half done when all objections have been removed and approval given. Perfect harmony reigns—but somehow the plan is not working!

But "Look! Listen!": Whatever improvements the inspector advocates, he should invariably make suggestions affecting other departments through, or after consultation with, the officers concerned. Otherwise he may be a great source of danger through real, unwise, interference. The views of the beneficiary should always be obtained.

(B) *The Inspector as Assistant Umpire.*—Where differences of opinion exist between the heads of yard departments, or between divisional and ships' officers, it may be convenient to the commandant to get technical advice from a third, disinterested party, with an investigating staff of his own.

(C) *The Inspector as Special Investigator.*—Many questions as to shop arrangements, methods of accounting, disposition of personnel, etc., are put up to the commandant for decision and involve extensive investigation. It has been found convenient to turn over matters of this kind to the inspector for investigation and report. If thorough, impartial, and judicious, he may thus be very useful in saving time to the commandant. He can get the views of both sides (if there are two), verify, boil down, and digest. Examples of matters thus referred are: Recommendation as to a new method of accounting for target material; request for the installation of a crane; a working arrangement for carpenters carried on the rolls of one division and used by another. *Facts,* conflicting considerations, and recommendations should be presented in each case.

(D) *The Inspector as Handy Billy.*—This discussion would not be complete without reference to another phase of inspection duty. It is natural—yet, it seems, unfortunate—that an officer with the diversified duties described above should be given still others that have no natural connection with his billet. A reason for this is that the yard machinery can always move without him. But the tendency to pick him up for boards, courts-martial, detached duty, and what not, is very demoralizing. The first time an inspection department hardly yet organized came within the writer's ken, the supposed head of it was detailed as an examiner, and almost constantly absent, for *two weeks*. Small wonder that some persons questioned the usefulness of his department!

The rational remedy for this state of things seems to be having at each yard one or two officers detailed especially for board duty.

RELATIONS OF THE INSPECTOR.

Closely allied with the subject of the inspector's duties is that of his relations with other persons in the yard.

1. *Relation to the Commandant.*—This has been sufficiently indicted. As an outdoor aid and technical adviser, he gives the commandant first-hand information of defects in work, shop methods, and yard conditions—suggesting remedies when he can. He is presumably impartial and "responsible to the commandant only."

2. *Relation to Manufacturing Heads.*—It is impossible for the administrative head of a manufacturing division to spend much time in the shops and yard. His subordinates are not always frank or disinterested. He can therefore, like the commandant, get much useful information from the officer whose business is *observing*. Reports of defects should often be made to him, rather than to the commandant, unless (a) suggestions are ignored; (b) the defect is typical and likely to be repeated until a general remedy is applied. In fact, the principle in question extends further—so long as faults are remedied, assistants should deal directly with foremen and leading men without consuming the time of the inspector and the divisional heads. This method causes less friction, is quicker, and is often more effective.

3. *Relation to Accounting Officer.*—The inspector and the "cost accountant" should co-operate strongly. One furnishes technical data; the other, costs. If figures are suspicious, the

accounting officer furnishes the clue for the inspector to follow. The summaries of estimated and actual costs offer much material for investigation. During the progress of certain work, an assistant investigating its cost gets daily charges against it from the accounting office. To illustrate the above:

(a) The cost of a certain box seems high. Examination of time cards shows that *first-class* labor was charged for *three* days, whereas a *third-class* man should have done the work in *two* days.

(b) Comparison of two summaries of costs shows that a valve for the *West Virginia* cost $50, while two similar valves for the *Colorado* cost $66. Evidently these charges require looking into.

(c) A charge in the foundry appears against the job order for the manufacture of a hammock. The accounting officer's attention is called to this. He investigates, finds a clerical error, and corrects the invoice price.

(d) The accounting officer notes that an expense account is growing from month to month. The inspector investigates and finds improper charges.

4. *Relation to General Storekeeper.*—The points of mutual interest to the inspector and general storekeeper may be summed up as follows:

The inspector is required to examine stores as to their condition.

He should also advise the general storekeeper as to the need (or lack of need) of certain articles of stock.

He should call attention to cases where work is held back through delays in delivery of material.

He should make report of articles not on charge, or not pertaining to special work, that should be turned into store.

He may advise as to the handling of scrap metal.

His duties with regard to surveys have been explained. He should inspect sale lots, and (when advisable), recommend withdrawals. If too many articles are held for the repair of others, or for repair when needed, he should recommend resurvey.

This list might be extended; but the close relation between the inspection and storekeeping departments is sufficiently clear.

5. *Relation to Ships.*—Ships' officers are required to inspect their own work. At one important navy yard they act quite independently of the yard department. This relieves the inspector and economizes time. It is found, however, that the yard in-

spectors can be of considerable value in watching shop work for ships, and in checking ship inspections on board. As stated above they can usually expedite work to advantage.

This feature of inspection duty has not been fully developed. If the inspector lacks assistants he is glad to let the ships alone; moreover, some ships' officers know very little about the inspection department.

6. *Relation to Workman.*—On the whole, the relation between inspection departments and foremen, leadingmen, and workmen seems to have been friendly—perhaps more friendly than a thoroughly efficient inspection force could expect. If defects are shown the workman and leadingman direct, and not made the subject of complaint, there should be no ill feeling. Certain narrow-minded workmen regard all members of the inspection force as "spies"; but this feeling is by no means general. A more general disposition is to regard them as idle spectators. In some cases inspection duty *is* performed in too leisurely a way, for it takes time to establish an *esprit* in a new department.

Some good suggestions as to methods of work or defects can be obtained direct from intelligent and well-disposed workmen. On the other hand, the inspector can do the men a friendly turn by reporting cases of bad lighting or ventilation, excessive heat or cold, unsanitary conditions, etc., observed in the shops.

CAUSES OF FUTILITY.

In what precedes the writer has tried to show what tends to make the inspector effective. The other side must be looked at. Why are his efforts sometimes futile?

Resentment of Criticism leading to Opposition.—Few people fail to resent criticism. Workmen, foremen, assistants, heads of departments, inspectors, often do resent it. The result may be a conscious or sub-conscious state of opposition to ideas of the critic. Those who, in an ideal world, would welcome his good suggestions sometimes, in human exasperation, damn whatever he proposes. Moreover, department heads may not like having the efficiency of their subordinates questioned. Foremen and others, feeling that the criticism is a hostile act, may not pass on it dispassionately. Opposition results in beclouding the issue and postponing the remedy.

Reference to Interested Foremen.—A good suggestion often falls dead because the man criticised is made the judge. A report is put in to the commandant, who refers it for comment to the head of division concerned. The latter, too busy or too little interested in outside reports to investigate personally, refers the matter for an answer to the very foreman whose methods are criticised. His report is signed by the head of department and forwarded to the commandant, who, considering the complaint answered, lets the matter drop.

An amusing instance of this came under the writer's observation. It was reported to an inspection officer that a superfluous man was being used on a planing machine. Before making the report the assistant had quite properly pointed this out to the leadingman, who, seeing that the suggestion was good, made the change and continued the work without difficulty. Meanwhile the inspector addressed an official memorandum to the head of department, who, after consulting the foreman interested, reported several days after the change had been made that it was "impracticable."

Pocket Vetoes.—If the inspector's efforts are not welcome, an easy way to nullify them is through the deadly pigeon-hole. This does not apply to specific rejections of work, which cannot be ignored, but to all general comments or suggestions. Even the broad-minded officer who is anxious to co-operate with all who can help him will "let sleeping dogs lie" because the pressure of routine is strong. What *must* be done crowds out what *may* be done. The result is that many good suggestions are buried alive. The writer recalls a case where an able and active staff officer, when cleaning house on detachment, found papers on his desk that had been there a year.

Fatal Delays.—Often after papers have run their course, the action taken is too late. It is discovered that a certain job order should be cancelled and purchase substituted for manufacture. The commandant or divisional head refers the report to an officer, who in turn refers it to a foreman. The change is finally recommended and the suggestion *approved*. Meanwhile the article has been duly manufactured and the ship has sailed! This may seem due to dilatory methods on the inspector's part. Not always so. The leadingman, even when advised direct, may await the word from someone up the line who hasn't reached a paper in his basket.

Perfunctory Action.—The greatest danger of futility lies in the fact that when reports *are* acted on promptly, their real meaning and usefulness is overlooked. Higher authority may fail to analyze them, study the questions raised, or issue orders that are the logical sequence of approval. The specific case may be settled and the principle left untouched.

It is reported that a foreman has been making fictitious charges against a job. One method of handling this report is to investigate and approve it—or to correct the charges. Another method is to investigate the foreman.

REMEDIES.

The above is written in anything but a pessimistic spirit. If the inspection department makes good, most of these troubles will cure themselves. In that case a feeling of permanency will greatly strengthen its hand. When General Order No. 53 has sunk in, and officers have grown familiar with it in practice, they will grasp the purpose and possibilities of the new department and will know how to use it. Its true usefulness will begin when it has won the confidence of commandants, department heads, and workmen. "By their fruits ye shall know them."

The elimination of unnecessary papers, and the centralization of offices and files should gradually remove the special difficulties referred to in connection with the handling of reports.

This result will be forwarded by an improved organization that will leave the higher yard officers freer from routine and better able to take up the class of questions raised by the inspector.

Gradual improvement in the organization of the inspection department, and the building up of an inspection *esprit*, will make the department what it should be. It takes years to develop methods of doing a new class of work; and years to build up the spirit that will make assistants ready to plunge in, work, and *speak out* for the good of the service.

RESULTS OBTAINED.

One's optimism is confirmed by looking over the record of the new department. At the larger yards, notwithstanding the good quality of work in general, hundreds of jobs pronounced complete have been rejected *for cause;* hundreds of cost reports

have been made with definite comment as to responsibility; numerous general recommendations have been made and approved.

From one yard, for instance, the following data was furnished for the fiscal year, 1910-11:

Number of job orders passed on	5550
Number reported unsatisfactory	250
Number of reports of excessive cost	186

The following are typical examples of general recommendations made by inspectors and approved. In some cases the matter had been bruited before; but for want of following up or of definite recommendations nothing had been accomplished:

Removal and sale of obsolete and useless machine tools.

Establishment of a proper stowage and cataloguing of dies.

Establishment of a custody storehouse for material removed from ships but invoiced to yard.

Systematic procedure as to packing and crating, involving use of old packing material.

Classification of costs of manufacture of standard patterns.

Preventing accumulation of material not on charge.

Preparation of supplementary job orders and estimates in case of work on jobs not originally contemplated.

Purchase instead of manufacture in various cases.

Postponement until needed of repairs on surveyed articles of doubtful value.

Steps to prevent deterioration of rubber in store.

Steps to prevent deterioration of machinery in store.

Systematizing work on manholes on shipboard.

Better co-ordination between draughting rooms and shops.

Steps to remedy excessive heat in sail loft.

This list might be greatly extended; but the above suggests the variety and importance of feasible suggestions emanating from inspection departments. No mention is made of extensive investigations and recommendations that have not yet borne fruit.

The great improvement in methods of inspection by ships' officers should also be noted. Work is followed up carefully, and records are systematically kept.

Finally, the best evidence of good silently accomplished is the absence of vociferous complaints as to bad work, delays, and wasteful methods, so common a few years ago.

FUTURE OF THE INSPECTION DEPARTMENT.

Granting the necessity of inspections in some form, and admitting the advantages of a separate department; accepting the ideals of such a department and realizing its difficulties—the final question is: Shall we keep or discard the inspection department?

It seems logical that it should continue as an essential part of the modern navy yard organization. We must remember that the quality of the output is not checked, as in a civilian plant, by competition and the demands of the consumer. There are no other "resident inspectors." The government, forced to patronize, *must inspect for itself*. Adopting as desirable the idea of an inspector for each shop, we must decide: Shall he report to his foreman or to a chief inspector responsible only to the commandant? The answer seems plain.

In this case, the chief inspector should have a small staff who, freed from even an inspection routine, may give undivided attention to general investigations. What has been done already shows what might be done. By a system of interchange, results obtained at one yard could be extended to others.

With the shop inspectors watching details and the chief inspector keen for large improvements, the people, demanding good workmanship in exchange for their millions, might have a confidence that figures fail to give.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

WILLIAM BARKER CUSHING.

By CHARLES W. STEWART.

> On four previous occasions the Department has had the gratification of expressing its approbation of your conduct in the face of the enemy, and in each instance there was manifested by you the same daring and innate love of perilous adventure—a mind determined to succeed and not to be deterred by any apprehensions of defeat. (Extract from letter of Secretary of the Navy to Lieutenant Cushing, November 9, 1864, relative to the sinking of the Confederate ram *Albemarle*.)

The biography that tells when a man is born, married, died and a few other important events in his life is easily prepared and is of little value. The real history of the man should reveal the motives and aims that impel him in his life struggle, his joys and sorrows, triumphs and disappointments, hopes and fears. It should present the summing up of the fruits of his life. A great soul fully unveiled would be a treasure for all time; but this we can never have. We can only form an imperfect judgment of men by their acts, speech, and correspondence, as we may know them and reason from them. What better can a man do than to leave to the world a good example, and what better can a writer do than to publish and preserve the story of the brave and the true! The acts, habits, character, of the man Cushing are unusual; he lifted the sword from pure notions. His conscience was in his work. He was never wounded yet his deeds of heroism are many. Generous, good and gallant, he commands the respect of all men, and his story will live as an enduring monument.

William Barker Cushing, born 1842, died 1874, served in the United States Navy from 1857 until his death, excepting only a few weeks in the year 1861. He achieved in the Civil War, and before he had completed the twenty-second year of his life a name and a fame apart from that of all other officers in our navy. From 1861 to 1865 he was conspicuous for his courage and gallantry in many daring and hazardous exploits, most of which he personally

planned and executed, ranging from the burning of blockade runners under the enemy's guns to his supreme success, the blowing up of the Confederate ironclad ram *Albemarle*.

It is difficult to describe in trite terms the unflinching fortitude, the undaunted valor, the brave heart of this boy, who was a hero in every sense and meaning of the word. An account of his life is an essay on courage, a story of valor and victory.

Cushing's ancestors were of sterling New England stock, Anglo-Saxons, sprung from the valiant races of Northmen, the greatest sea-fighters of the world.

Zattu Cushing, a ship carpenter, born at Plymouth Rock, attained his majority in 1791 and left his father's home and ship repair yard at Plymouth, Massachusetts. At Ballston Spa, New York, he married Miss Rachel Buckingham in 1795. He built the good ship *Good Intent* at Erie in 1799. In 1805 he settled as a pioneer at what is now Fredonia, New York, with his wife and several children, among them Milton Buckingham Cushing, destined to become the father of our hero. Here Zattu lived, a devout churchman, successful business man and a presiding judge, until his death in 1839. A volunteer soldier at the battle of Buffalo, but always a leader resourceful, energetic, and of indomitable will, he was a fine example of American manhood.

The son Milton studied medicine and practiced at Zanesville, Ohio, where he became a husband and a widower. Later, while engaged in business at Columbus, Ohio, he met and married, in 1836, Miss Mary Barker Smith,[1] of Boston, aged 28.

What a thing it is to be well-born and to feel the impulses imparted by generations of honorable ancestors such as these, who gave to William Cushing his heritage of valor and virtue.[2]

[1] It is recorded that (1) Thomas Smith of Brinsspittae, England, bore a son (2) Rev. John Smith, who settled at Barnstable, Mass., in 1630 and married Susannah Hinckley: Their son (3) Joseph Smith, in 1689, married Ann Fuller, who bore thirteen children, the ninth being (4) Rev. Thomas Smith, who married Judith Miller in 1734: Their son (5) Josiah Smith married Mary Barker in 1760 and bore (6) Elisha Smith, who married Mary Butler Bass, 1806: Their first born (7) Mary Barker Smith, married Dr. M. B. Cushing at Columbus, Ohio, in 1836, and became the mother of Milton, Howard, Alonzo, William and Isabel Cushing, as set forth.

[2] When Commodore Joseph Smith, nephew of (6) Elisha Smith, heard in Washington the telegram announcing that the U. S. S. *Congress*, commanded by his son, Lieutenant Joseph Smith, had surrendered at Hampton Roads, he quietly said "Then Joe is dead." How certain the father was of his son, both of the same blood as Cushing.

After the birth of their first son, Milton, the Cushing family moved West. Howard B., the second son, was born at Milwaukee in 1838. Near the present town of Delafield, Wisconsin, were born Alonzo H. Cushing in 1841; William Barker Cushing, November 4, 1842, and a daughter, Isabel, now Mrs. E. H. Bouton of Chicago. In 1844 Doctor Cushing moved to Chicago, and in 1847 to Gallipolis, Ohio, where he died in the same year. Mrs. Mary Barker Cushing, with her children, then moved to Fredonia, New York, where she established a successful school for children. Her boys aided in the support of the family.

In 1856 Hon. Francis S. Edwards, brother-in-law of Mrs. Cushing and a member of Congress, secured for William an appointment as page in the House of Representatives where he was a favorite with the members.

In 1857, through the aid of his kinsman, Commodore Joseph Smith, U. S. Navy, William was appointed a midshipman at the U. S. Naval Academy. Alonzo became a cadet at West Point in the same year.[a]

At the Naval Academy, Cushing was not noted for studiousness, but he stood fairly well in his first years, and in the first ten of his class in the latter years at the academy. He was fond of practical jokes and never felt that awe of his "superior officer" which oppresses most naval and military men from the cradle to the grave. He received 99, 188, 155, and 147 demerits during his first, second, third and fourth years respectively at the academy. The only serious report found against him was for overstaying his leave in January, 1861. This could not have been considered *very* serious, for but ten demerits were given him for that month and the offense was not mentioned in the report which caused his resignation in March, 1861. In his second class year, with 37 members, he stood 3 in gunnery, 8 in ethics, 13 in astronomy, and 9 in general order of merit, and last in conduct. For his first class year, with 27 members (at semi-annual examination in February, 1861), he stood 6 in ethics, 7 in gunnery, 9 in artillery, 11 in philosophy, 25 in modern languages and 6 in general order of merit, a high standing for a youth who has been considered as "not savvy."

[a] Lieutenant-Colonel Alonzo H. Cushing, U. S. Army, fell at Gettysburg, July 3, 1863, at the very apex of Pickett's Charge, in his twenty-second year. Howard B. Cushing, U. S. Army, was killed by Apaches in the Whetstone Mountains, Arizona, May 5, 1871. Paymaster Milton B. Cushing, U. S. Navy, retired, died January 1, 1886.

Cushing from boyhood was daring and dashing. He rode and drove horses at break-neck speed, climbed trees higher, swam farther and dived deeper than the other boys. He shot straight, hit hard, and feared no man. The story is told that, when a midshipman on leave, visiting his aunt, Mrs. Joshua Loring, at Chelsea, Mass., a youth named ———— on the sidewalk in front of the Universalist Church, commented sneeringly on his short uniform jacket, and Cushing went for him. The battle raged over the sidewalks and the dusty streets. Both fighters were covered with blood and dust, but the midshipman was the victor and afterwards walked the streets of Chelsea quite free from comments on his beloved uniform.

Cushing made clever pencil sketches and this accomplishment led to his most serious difficulty at the academy. The head of the department of modern languages was Professor E. A. Roget, a man of distinguished and dignified bearing, generally called "The Don." While the professor was crossing a street of Annapolis in January, 1861, he walked in front of a vicious cart horse that severely bit his shoulder. Sometime afterward on entering the section room he found his class laughing over a sketch on a fly-leaf of Cushing's book. He demanded the book and found a clever drawing of himself biting the neck of a horse, and the inscription "The poor old Don, he bit the hoss." The professor excitedly shouted out "I deed not bite the hoss. The hoss he bite me," and, when the class roared with laughter, the angry professor rushed over to the superintendent's house and demanded Cushing's immediate dismissal, which was, of course, refused. However, at the February examinations, in 1861, Cushing was found deficient in Spanish and the following report was forwarded by Superintendent Blake to the Department.

> Deficient at February semi-annual examination, 1861. Midshipman William B. Cushing. Deficient in Spanish. Aptitude for study: good. Habits of study: irregular. General conduct: bad. Aptitude for Naval Service: not good. Not recommended for continuance at the Academy.
>
> Endorsement.
>
> The same recommendation [refers to a preceding favorable recommendation that another midshipman of the first class be retained at the Academy and be turned back one year] cannot be made in the case of Midn. Cushing of the 1st class on account of the very unfavorable opinion expressed in this re-

port of his habits of study, conduct, and fitness for the naval service. He has been sick for a considerable time but this affords no palliation for neglect of study previous to his sickness nor for continued delinquencies in conduct throughout the term.

There is told the story that, in January, 1861, Cushing obtained leave for a week in order to be with a favorite aunt who was ill and lonely at a hotel in Washington, and he did not return to the Academy at the expiration thereof but asked for an extension. Captain Blake, the superintendent, meeting Commodore Smith and asking after Mrs. Smith's health, thinking she was the aunt whom Cushing was visiting, was surprised to learn that she was not ill, and on Cushing's return to Annapolis accused him of making a false statement regarding his aunt's health and need of his presence. Cushing, it is said, replied hotly and incurred Blake's enmity by his counter charge that the superintendent himself belonged in the Ananias class. It certainly was an unusual proceeding to dismiss a first classman, standing high in his class, for being unsatisfactory in Spanish, and one is forced to conclude that some personal resentment entered largely into the motives for prompting summary action in his case. It is said by his schoolmates that Cushing was careless in dress and spent a large part of study hours in visiting his friends, and playing pranks, thus acquiring many demerits. It is remarkable that a youngster of 18 years should be able to stand high in his studies with little effort, and it shows that he possessed a good memory, arranged facts logically, and had good nerves. He knew the habits of the watchmen, evaded them readily and could outsprint all of them. He would carefully hide a bottle for the zealous watchmen searching for whiskey to find, but the bottle would contain tea. One of his pranks was called "the tea-party." It was the custom to prepare large tin buckets of tea and to set them on a shelf outside the kitchen windows to cool. Cushing prepared a large hook which he lowered by a rope from an upper window, caught the pails with the hook, drew up the tea and after drinking a part and pouring out the rest, refilled the buckets with water and replaced them on the shelf below, much to the dismay of poor Dorsey the steward, who served that evening the weakest tea that ever graced the middies' supper table.

Half a century ago this skylarking boy played his tricks, danced and fought and laughed and sang, and bested most of his class-

mates, though the youngest of them all, an infant in the eye of the law. Seen through the haze and mists of 50 years it appears that Cushing did well, perhaps quite as well as the officers who condemned him.

Captain Blake's endorsement resulted in Cushing's resignation on March 23, 1861. Several of his classmates, who had resigned to go South, were in Washington and they suggested that he go with them, but to his credit he refused to do so. He spent some days with his friend, Lieutenant Charles W. Flusser, at Annapolis, and went with Flusser on one of his cutting-out expeditions. With a sinking heart he saw the Constitution and Baltic, carrying the midshipmen and Naval Academy outfit, sail for Newport, R. I., where the Naval Academy was located from 1861 to 1865. Flusser was a favorite with General B. F. Butler, commanding U. S. Army forces at Annapolis. Butler who had been at Bowdoin College the chum and room-mate of Gustavus Vasa Fox, the able Assistant Secretary of the Navy, asked Mr. Fox to consider Cushing's case, and with this aid and that of Commodore Smith, Cushing was accordingly appointed an acting master's mate and served from May to September, 1861, on the U. S. S. *Minnesota*, Flag-Officer Stringham's flagship in the Atlantic blockading squadron. As prize-master he took the *Delaware Farmer* to Philadelphia; and later with one volunteer officer and only the captured crew of the *Pioneer* safely sailed that prize to New York in May, 1861, standing watch and watch, with his one officer. This dangerous prize duty at an early age has frequently been cited as showing high courage and ability in other officers of our navy.

Cushing received from Flusser much good advice and also a charming little volume entitled "Naval Enterprise, Illustrative of Heroism, Courage and Duty." This little book, given by Fox to Flusser, and later by Flusser to Cushing, related inspiring stories of naval heroes, cutting-out expeditions, desperate struggles, forlorn hopes, audacious and successful attacks by sailors, seamen, midshipmen and officers, mainly of the British Navy, and it inspired Cushing to courageous deeds. Some of its phrases are found in the reports of Flusser and Cushing. A companion book entitled "Military Enterprise" gave stimulating stories of the achievements of soldiers from Leonidas at Thermopylæ, to Cardigan and Nolan of the Light Brigade in the Crimean War.

Cushing set out to gain the favor of the Department and his place in the naval service, encouraged by friends who understood

something of the spirit of this eighteen-year old boy. At Hatteras Inlet, on the *Minnesota*, flagship of Flag-officer Stringham, he did well, but in fun referred to his commander-in-chief as "Old Sting 'em" and gained the ill-will of the flag officer, who forwarded his resignation as acting master's mate with a cruel endorsement, although he knew that Cushing's intention and hope was to obtain reinstatement as midshipman in his class. Stringham later grudgingly admitted that Cushing's service as acting master's mate had been in some respects meritorious, and Captain Blake also later reported that he was of the opinion that Cushing could become a good officer and recommended his restoration as a midshipman in his class.

A story is told that during Cushing's service on the *Minnesota* he discovered a certain officer of the deck asleep on watch. This lieutenant had been particularly offensive to Cushing and had lorded it over his junior officers. On discovering the officer asleep on watch at night, Cushing called witnesses, and swung a lighted lantern in the face of the sleeping man to prove positively that he was asleep, but he later abandoned the first impulse of revenge, and upon considering the serious results of a Court Martial, and did not report his superior officer because he thought it would be taking a mean advantage.

Cushing's letters to his mother, written from the Naval Academy, express his love of the sea and of his profession, and of his mother, and of his desire to graduate and contribute to her comfort and support.

Extracts of two letters to his mother are given to show the resolute prize-master, aged 18 years, and man of religious faith, aged 19 years.

EXTRACT FROM LETTER DESCRIBING DUTY AS PRIZE-MASTER.

U. S. PRIZESHIP "PIONEER," May 24, 1861.

MY DEAR MOTHER: It is night and your youngest son is writing you in the cabin of the ship, *Pioneer*, now on her way to New York in my charge. This vessel belongs to Richmond, Va., and was captured three days ago for violating the blockade established by the President.

The *Minnesota* reached Hampton Roads nearly two weeks ago and the day after her arrival she captured a vessel loaded with tobacco and valued at about seventy-five thousand dollars. I was at once made prize-master of her and I carried her into Philadelphia. I then returned to the *Minnesota* and the following morning, was again a prize-master. So here I am on the broad Atlantic bound for New York. The flag officer could spare no men; so this ship's own crew of sixteen were left on board.

I have one man, master's mate of the *Cumberland,* named Harrington, to assist me and we have to keep unceasing watch and watch sharply.

As I write, I feel the weight of a brace of revolvers on my belt, and I know not at what moment the crew may try to retake her; but your boy is ready, and I trust no son of yours is a coward.

Now I must go and have the pumps sounded in order to see that none of the crew have scuttled her. Give my love to all dear friends.

Your affectionate son,

W. B. CUSHING.

EXTRACT FROM LETTER DESCRIBING A STORM AND HIS FAITH.

U. S. S. "CAMBRIDGE," Feb. 24, 1862.

MY DEAR MOTHER: It is blowing as if all the "Nor'westers" in the world had been tied up for the last twenty years, and had just broken loose. The waves have been rolling twenty feet high all the afternoon, dashing against us, and making the old ship shiver like a freezing giant.

The lower and top sail yards have been sent down and the top-masts "housed." The wind howls through the rigging and the waves beat madly against us, waves that would almost dash right over our house at home. Madly they strive to rend this stout oaken frame, timber from timber.

Yet, how calm I feel, just the same as in the most beautiful calm that ever fell upon the bosom of old ocean.

A huge, roaring foam-crested mass of water comes dashing over the bows and sweeps the deck, fore and aft. Yet here am I with only six inches of plank between myself and the wild, deadly, sublime wrath of Nature's moving throne.

If there is one time more than another when one realizes God's greatness and His mercy, it is at such a moment as this. A man who has a heart must think of the time when Christ said to such a sea "Peace! Be still."

He is *now* with those who are their country's defenders as He was with the apostles of old. His shield guards us and His arm is between us and death.

I am not, as yet, what the world calls a Christian, but I do believe implicitly in God's power and goodness, and that not even a sparrow can fall to the ground without His knowledge.

Often, I feel as held in the hand of God.

"They that go down to the sea in ships, that do business in great waters; these see the works of the Lord and his wonders in the deep."

As usual it is very late and I must turn in.

Give love to all dear ones.

Your affectionate son,

WM. B. CUSHING.

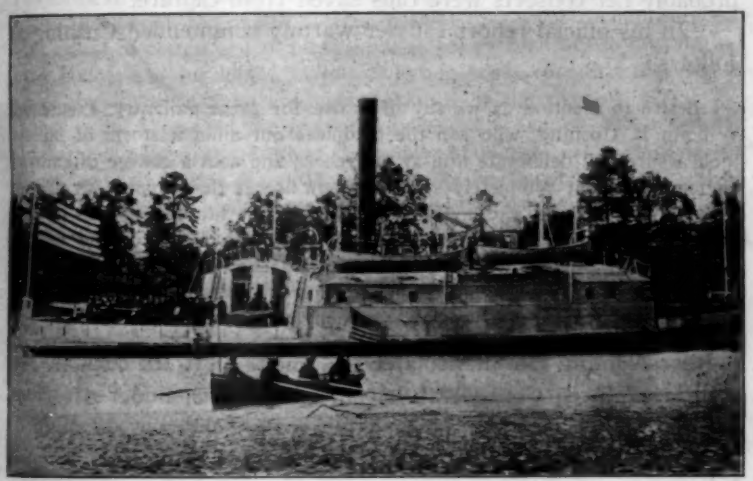
Restored to the navy in October, 1861, as an acting midshipman, Cushing was assigned to the North Atlantic Squadron, and on the U. S. S. *Cambridge* became ill from over-work and exposure; was

granted sick leave in March, 1862, ordered again to the *Minnesota in* May and gained some reputation for daring and courage as opportunities offered.

The increase of the commissioned personnel by Act of July 16, 1862, made Cushing a lieutenant at the age of 19. Cushing wrote from the *Hunchback,* August 20, 1862, to his mother as follows:

MY DEAR MOTHER: For the last two weeks I have been in the City of Newbern waiting for Commander Davenport to return so I could report for duty.

I asked permission to go down to Plymouth as first lieutenant of the gunboat *Commodore Perry.* I want to go there because Lieut-Commander Flusser is the fighting man of the Sounds and we are going to attack a



U. S. S. "COMMODORE PERRY."

seven-gun battery up Roanoke River. Flusser is daring to the death and chuck full of fight. The engine shakes the vessel so it would be hard to write if there were no other cause, but when you add a nor'-westerly gale and a heavy head sea, you can imagine it is next to impossible to write. However, if you can read it, it is all that is required.

I am promoted. Not one grade but three. Perhaps it will interest you, mother, to know I am the only man who has ever reached this rank at anywhere near my age. I am not yet twenty. Aren't you glad for me, mother, dear?

Flusser asked for him and he was made executive officer of the *Commodore Perry.* Under Flusser's eye he performed a deed of gallantry that deserved immediate and substantial recognition. As the little squadron of three wooden steamers was descending

the Blackwater River after the battle of Franklin, October 3, 1862, the *Commodore Perry* jammed her bow into the bank at Crumpler's Bluff and was charged by a strong force of Confederates. Flusser ordered all hands to cover, but Cushing called for volunteers, ran a field-piece out on the forecastle of the *Perry* and, although every man with him was killed or wounded, he bided his time, took careful aim and at the proper moment pulled the lanyard and discharged his howitzer in the faces of the advancing enemy, who were thrown into confusion by the unexpected roar and storm of missiles, and were driven off with heavy loss by Flusser's men who reappeared from under cover. The *Commodore Perry* and probably her consorts were thus saved from capture.

In his official report Flusser warmly commended Cushing as follows:

> I desire to mention as worthy of praise for great gallantry, Lieutenant William B. Cushing, who ran the fieldpiece out amid a storm of bullets, took a sure and deliberate aim at the rebels, and sent a charge of canister among them that completely silenced their fire at that point. Mr. Lynch assisted Mr. Cushing, and here met his death like a brave fellow, as he was. Mr. Richards, third assistant engineer, who had charge of the powder division, also assisted with the howitzer, and showed great courage.
>
> Mr. Anderson, the paymaster, was of great assistance in bringing in the wounded from under the fire, and conveying them to the doctor.

Rear-Admiral Lee immediately assigned him to the command of a little captured Confederate steamer, the *Ellis,* under a sort of roving commission. He burned the roving schooner *Adelaide* of Halifax, and later destroyed a large salt works in New Topsail Inlet.

Cushing's visit to the enemy's country and capture of Jacksonville, N. C., in November, 1862, and the loss of his vessel due to grounding under the enemy's guns are described in the following official correspondence. Although he lost his vessel he did it with such coolness and courage that he received the warm commendation of his superiors.

> U. S. S. "HETZEL," Off New Berne, N. C., November, 27, 1862.
>
> SIR: I have the honor to enclose herewith a report of Lieutenant William B. Cushing of his operations at New River Inlet, by which you will perceive that the U. S. S. *Ellis* is lost.
>
> I trust that, in consideration of the courage, coolness, and gallantry displayed on the occasion by Lieutenant Cushing, his course may meet with the approval of yourself and the honorable Secretary of the Navy.

I have the honor to be, very respectfully, your obedient servant,

H. K. DAVENPORT,
Commander and Senior Officer in Sounds of North Carolina.

ACTING REAR-ADMIRAL S. P. LEE,
Commanding North Atlantic Blockading Squadron.

(Enclosure.)

U. S. S. "HETZEL," November 26, 1862.

SIR: I have the honor to report that I entered New River Inlet on the 23d of this month with U. S. S. *Ellis* under my command; succeeded in passing the narrow and shallow place called "The Rocks," and started up the river. My object was to sweep the river, capture any vessels there, capture the town of Jacksonville, or Onslow Courthouse, take the Wilmington mail, and destroy any salt works that I might find on the banks. I expected to surprise the enemy in going up, and then to fight my way out.

Five miles from the mouth I came in sight of a vessel bound outward, with a load of cotton and turpentine. The enemy fired her to prevent her from falling into our hands. I ran alongside, made sure that they would not extinguish the flames, and again steamed up the river.

At 1 p. m. I reached the town of Jacksonville, landed, threw out my pickets, and placed guards over the public buildings. This place is the county seat of Onslow County, and is quite an important town. It is situated on the right bank of the river, going up, and is 35 or 40 miles from the mouth. I captured 25 stand of public arms in the court-house and post-office, quite a large mail, and two schooners. I also confiscated the negroes of the Confederate postmaster. I forgot to mention that the town is situated on the main dirt road to Wilmington. Several rebel officers escaped as I neared the place and carried the news to that city. At 2.30 p. m. I started down the river, and at 5 p. m. came in sight of a camp on the banks, which I thoroughly shelled. At the point where the schooner captured in the morning was still burning, the enemy opened fire on the *Ellis* with rifles, but were soon silenced by our guns. I had two pilots on board, both of whom informed me that it would be impossible to take the steamer from the river that night. High water and daylight were two things absolutely essential in order to take her out. I therefore came to anchor about five miles from the outer bar, took my prize alongside, and made every preparation to repel an attack. All night long the signal fires of the enemy could be seen on the banks. At daylight I got underway, and had nearly reached the worst place in the channel when the enemy opened on us with two pieces of artillery. I placed my vessel in position; at once hoisted the battle flag at the fore; the crew gave it three cheers and we went into action. In one hour I had driven the enemy from his guns and from the bluff and passed within a hundred yards of their position without receiving fire. Up to this time I had been in every way successful, but was here destined to meet with an accident that changed the fortune of the day and resulted in the destruction of my vessel. About 500 yards from the bluffs the pilots, mistaking the channel, ran the *Ellis* hard and fast aground. All hands went to work at once to lighten her, and anchors and steam used to get her afloat, but without success. The headway of the steamer had forced her over a shoal and into a position where, as the center of a circle,

we had a circumference of shoal all around. When the tide fell I sent a party ashore to take possession of the artillery abandoned in the morning; but when they reached the field it was discovered that it had been removed while we were at work on the vessel. If I had secured this, I proposed to construct a shore battery to assist in the defense of my vessel by keeping the rebels from placing their batteries in position. At dark I took one of my prize schooners alongside and proceeded to take everything out of the *Ellis* excepting the pivot gun, some ammunition, 2 tons of coal, and a few small arms. Steam and anchor again failed to get my vessel afloat. I felt confident that the Confederates would come on me in overwhelming force, and it now became my duty to save my men. So all hands were called to muster and the crew told that they could go aboard the schooner. I called for six volunteers to remain with me on board and fight the regaining gun. Knowing that it was almost certain death, the men came forward, and two master's mates, Valentine and Barton, were amongst the number. These gentlemen subsequently behaved with coolness and bravery. I ordered the schooner to drop down the channel out of range from the bluffs, and there to wait for the termination of the impending engagement, and if we were destroyed, to proceed to sea.

Early in the morning the enemy opened on us from four points with heavy rifled guns (one a Whitworth). It was a cross fire and very destructive. I replied as best I could, but in a short time the engine was disabled and she was much cut up in every part, and the only alternatives left were surrender or a pull of one and a half miles under their fire in my small boat. The first of these was not, of course, to be thought of; the second I resolved to attempt. I fired the *Ellis* in five places, and having seen that the battle flag was still flying, trained the gun on the enemy so that the vessel might fight herself after we had left her, and started down the river, reached the schooner, and made sail for sea. It was low water on the bar and a heavy surf was rolling in, but the wind forced us through after striking several times. We were just in time, for about 600 yards down the beach were several companies of cavalry, trying to reach the mouth of the inlet in time to cut us off. We hoisted our flag, and gave three cheers and were off. In four hours I reach Beaufort. I brought away all my men, my rifled howitzer and ammunition, the ship's stores and clothing, the men's bags and hammocks, and a portion of the small arms. I retained aboard a few muskets, pikes, and pistols to repel boarders.

I neglected to state that when I took possession of the enemy's ground on the 24th a salt works was destroyed and ten boats rendered useless that were to have been used for boarding. At 9 a. m. the U. S. S. *Ellis* was blown in pieces by the explosion of the magazine. Officers and men behaved nobly, obeying orders strictly under the most trying circumstances. I respectfully request that a court of enquiry may be ordered to investigate the facts of the case, and to see if the honor of the flag has suffered in my hands.

I am, sir, very respectfully, your obedient servant,

WM. B. CUSHING,
Lieutenant.

COMMANDER H. K. DAVENPORT,
Senior Officer, Commanding in Sounds of North Carolina.

(Endorsement.)

Respectfully submitted. I think the course of this young officer should meet with the commendation of his superiors.

H. K. DAVENPORT,
Commander and Senior Officer.

(Second Endorsement.)

Received and forwarded, December 2, 1862, with the expression of my admiration of Lieutenant Cushing's coolness, courage, and conduct.

S. P. LEE,
Act. Rear-Admiral, Comdg. North Atlantic Blockade Squadron.

Captain William Harwar Parker, of the United States and Confederate Navies, in "Recollections of a Naval Officer," wrote:

Young Cushing had been a pupil of mine at the Naval Academy in 1861. He was rather a delicate looking youth; fair, with regular, clear-cut features, and a clear grayish-blue eye. He was first brought to my notice during the war by my happening to get hold of his report of the loss of the U. S. Steamer *Ellis*, under his command at New River Inlet, Nov. 24, 1862. I was impressed with this part of his official report (the italics are mine): "and the only alternatives left were a surrender or a pull of one and a half miles under their fire in my small boat. The first of these was not, *of course*, to be thought of." Knowing him to be at that time but 19 years old, I comprehended his heroic qualities and was not at all surprised to hear more of him. Immediately after the war I went to San Francisco, and my first visitor was Cushing. He was the hero of the hour, and the citizens made much of him. Under the circumstances I thought he conducted himself with much modesty.

Admiral David D. Porter, U. S. Navy, wrote:

Flusser was a cool and daring officer. He was always to be found where fighting was going on.

There was another young officer in the North Atlantic Squadron at this time, Lieutenant William B. Cushing, who made a name for himself by his total disregard of danger.

He would undertake the most desperate adventures where it seemed impossible for him to escape death or capture, yet he almost always managed to get off with credit to himself and with loss to the enemy. He commanded the small gunboat *Ellis*, and in November, 1862, it struck him that he would enter New River Inlet, push up the river, sweep it clear of vessels, capture the town of Jacksonville or Onslow Courthouse, take the Wilmington mail and destroy any salt works he could find on the banks. He expected to surprise the enemy on going up, and then fight his way down. The account of the loss of the *Ellis* is given as an illustration of this young officer's character and his fancy for seeking adventures. There was nothing particularly to be gained by his trip up New Inlet River, and there was a chance of losing his vessel. He lost her, but in doing so, showed his spirit of adventure, risking his life and the lives of his men,

and then escaping with his crew, arms, provisions and clothing, setting fire to his vessel and training her guns upon the enemy so that she might give them a broadside as she went out of existence.

One of the schemes of Cushing for capturing Wilmington pilots by disguising his vessel, a schooner, as a blockade-runner, and enticing the pilots aboard was frustrated by the weather and vigilance of the enemy, yet he succeeded in capturing and destroying a Confederate camp.

U. S. S. "HETZEL," New Berne, N. C., November 26, 1862.

SIR: I respectfully request that I may receive orders to take the prize schooner *Home* for the purpose of capturing some Wilmington pilots. I propose to disguise her as an English vessel, painting her lead color, altering her rig, etc. By boldly entering New Inlet, chased by one of the blockading fleet, I can succeed. When I get under the guns of the forts I will wait for pilots or boats from the shore. All persons that come aboard I will make prisoners, and stand out from under the fire of the forts. If an armed tug should come alongside I will take her by boarding.

I am, sir, very respectfully, your obedient servant,

WM. B. CUSHING,
Lieutenant U. S. Navy.

COMMANDER H. K. DAVENPORT,
Senior Officer, Commanding in Sounds of North Carolina.

U. S. S. "HETZEL," Off New Berne, N. C., November 29, 1862.

SIR: In reply to your letter of the 26 instant, asking permission to take the prize schooner *Home* for the purpose of capturing some Wilmington pilots, I have to state that upon careful consideration of your proposition I deem it advisable that you should bring the subject to the notice of the acting rear-admiral and receive his instructions.

You will therefore proceed by first opportunity to Hampton Roads, and on your arrival there report to Acting Rear-Admiral Lee on board the U. S. flag steamer *Philadelphia*.

I am, etc.,

H. K. DAVENPORT,
Commander, etc.

LIEUT. WILLIAM B. CUSHING, U. S. Navy.

U. S. S. "HETZEL, New Berne, N. C., December 26, 1862.

SIR: I beg leave to state that in conversation with Acting Rear-Admiral Lee, and also with the Assistant Secretary of the Navy, both approved of the enterprise which I have in contemplation; and I leave for Beaufort tomorrow and will do my best to carry out my plans.

WM. B. CUSHING,
Lieutenant, U. S. Navy.

COMMANDER H. K. DAVENPORT,
Commander and Senior Naval Officer in Sounds of North Carolina.

EXTRACT FROM A LETTER FROM THE ASSISTANT SECRETARY OF THE NAVY TO REAR-ADMIRAL LEE, U. S. NAVY.

NAVY DEPARTMENT, December 9, 1862.

I told him (young Cushing) he might go at any scheme you consented to. Rashness in a young officer is rather commendable. Blunt has sent you four pilots. The pilots in Fort Lafayette are not to be trusted. The *Sunbeam* had an English pilot and Seward lets them all go.

ACTING REAR-ADMIRAL S. P. LEE,
Comdg. North Atlantic Blockading Squadron, Old Point Comfort.

U. S. S. "HETZEL," December 26, 1862

SIR: In reply to your letter of this date, I will say that in consequence of the approval of Acting Rear-Admiral Lee and the Assistant Secretary of the Navy of your plans you are ordered to proceed to carry them out at once.

I am, sir, very respectfully, your obedient servant,
H. K. DAVENPORT,
Commander, etc.

LIEUTENANT W. B. CUSHING, U. S. NAVY.

U. S. FLAGSHIP "MINNESOTA," NEWPORT NEWS, Va., January 9, 1863.

SIR: I have the satisfaction of enclosing a copy of a report (January 8) from Lieutenant W. B. Cushing, regarding the results of an enterprise, conceived and carried out by him under my sanction, to capture Wilmington pilots, and which, though unsuccessful in its immediate object both as Cape Fear River and at Little River, where he landed and carried by storm an earthwork, does great credit to the gallantry of this promising young officer.

I have the honor to be, sir, very respectfully, yours,
S. P. LEE,
Actg. Rear-Admiral, Comdg. North Atlantic Blockading Squadron.

HON. GIDEON WELLES,
Secretary of the Navy, Washington, D. C.

I have already ordered Lieutenant C. here to command the *Commodore Barney*.

CUSHING'S REPORT.

BEAUFORT, N. C., January 8, 1863.

SIR: I have the honor to report that I failed to capture the Wilmington pilots because my schooner was three times becalmed, inshore, at the points where I desired to act. Having learned, however, that there was a pilot station at Little River, 30 miles below Fort Caswell, I made sail for that point and reached it on the morning of the 5th. At 8 o'clock at night I crossed the bar with three cutters and twenty-five men, and proceeded up the river. My object was to look for pilots, and also to find some schooners

supposed to be inside. About a mile from the mouth the enemy gave us a volley of musketry from a bluff on the left.

I beached the boats at once, formed my men about 200 yards from the enemy's position, and gave the order, "forward; double quick; charge." Without firing a musket the men moved forward, and when we got clear of the woods I saw a fort in front and the light of the camp fires. Knowing that the rebels were ignorant of our numbers, I charged with the bayonet and captured their works, going over one side as they escaped over the other. I found the fort an earthwork, surrounded by a ditch about 10 feet broad and 5 feet deep. Inside was a blockhouse pierced for musketry. No guns were mounted. I learned that it was held by one company of infantry. The enemy left in such haste that their stores, clothing, ammunition, and a portion of their arms were captured. I destroyed all that I could not bring away. I went a short distance farther up the river; had another skirmish; did not see the schooners; got out of ammunition and returned with the loss of but one man shot in the leg. In conclusion, I beg leave to state that officers and men behaved nobly. Acting Master's Mates Valentine and Hicks were with me. Acting Master Savage, commanding mortar schooner *Matthew Vassar,* furnished me with two boats and a portion of men.

I am, sir, very respectfully, your obedient servant,

WM. B. CUSHING,
Lieutenant, U. S. Navy.

COMMANDER A. MURRAY,
Senior Officer, Commanding, Sounds of North Carolina.

P. S.—The fort was in South Carolina, 1 mile from the border line.

It has been asserted that Cushing was foolhardy and tremendously lucky, but the records clearly show that he planned carefully and executed vigorously. Further, his projects had the approval of the Navy Department, yet when failure seemed probable, he never lost his presence of mind and did the best thing in the best manner possible.

Admiral Porter wrote of this event:

On January 5 the indefatigable Lieutenant Cushing started on an expedition to capture some Wilmington pilots, and having heard that there was a pilot station at Little River, thirty miles below Fort Caswell, he made sail for that point, and reached it on the morning of January 5, 1863. He crossed the bar at 8 o'clock at night with twenty-five men, in three cutters, and proceeded up the river. He was in the hopes of finding pilots above and also some schooners. About a mile from the mouth of the river the expedition received a volley of musketry from a bluff on the left. Cushing beached his boats the moment he was fired upon, without returning the fire, and formed his men about 200 yards from the point of attack, and gave the order: "Forward—double quick—charge!" The fearless fellow never stopped to consider whether he was charging fifty men or a thousand. It seemed immaterial to him, when his blood was up, how many of the enemy faced him; and his men inspired by his intrepid example, followed him without hesitation.

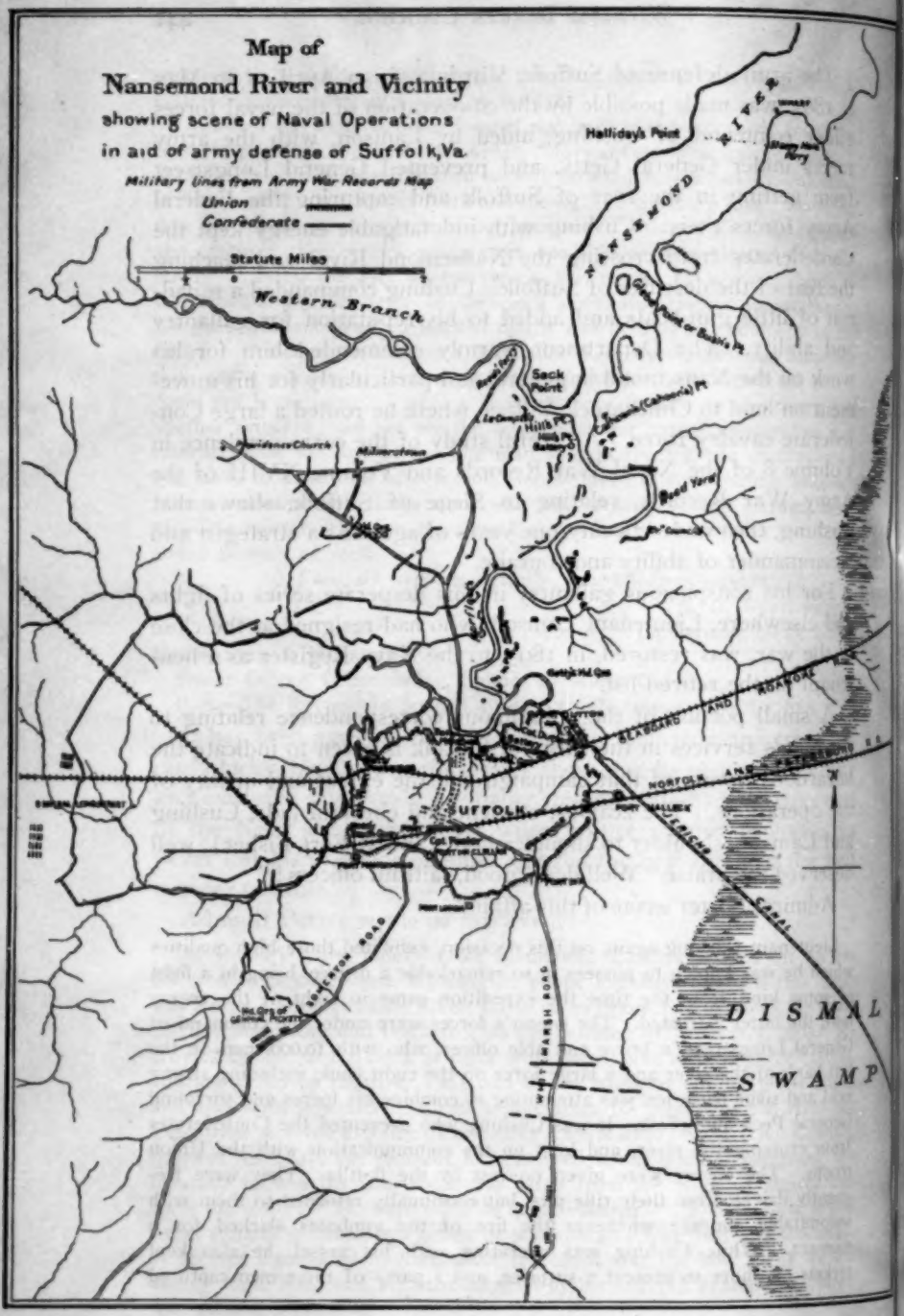
The army defense of Suffolk, Virginia, from April 11 to May 4, 1863, was made possible by the co-operation of the naval forces under command of Cushing, aided by Lamson, with the army forces under General Getty, and prevented General Longstreet from getting in the rear of Suffolk and capturing the Federal Army forces there. Cushing with indefatigable energy kept the Confederates from crossing the Nansemond River and reaching the rear of the defenses of Suffolk. Cushing commanded a squadron of little gun-boats and added to his reputation for gallantry and ability. The Department warmly commended him for his work on the Nansemond in general and particularly for his movement on land to Chuckatuck Village where he routed a large Confederate cavalry force. A careful study of the correspondence in Volume 8 of the Naval War Records and Volume XVIII of the Army War Records, relating to Siege of Suffolk, shows that Cushing, then under twenty-one years of age, was a strategist and a commander of ability and courage.

For his conspicuous gallantry in this desperate series of fights and elsewhere, Lieutenant Lamson, who had resigned at the close of the war, was restored, in 1895, to the Navy Register as a lieutenant on the retired list.

A small portion of the voluminous correspondence relating to Cushing's services in the Siege of Suffolk is given to indicate the hazardous nature of that campaign and the extent and quality of the operations. The zealous, efficient and cheerful lads, Cushing and Lamson, shoulder to shoulder here (and at Fort Fisher), well deserved the praise "Well done, good, faithful officers!"

Admiral Porter wrote of this affair:

> Lieutenant Cushing again, on this occasion, exhibited those high qualities which he was known to possess in so remarkable a degree, being in a fight of some kind from the time the expedition came in sight of the enemy until the latter retreated. The enemy's forces were under the command of General Longstreet, a brave and able officer, who with 10,000 men on the left bank of the river and a large force on the right bank, including strong field and siege batteries, was attempting to combine his forces and surround General Peck at Suffolk. It was Cushing who prevented the Confederates from crossing the river, and kept up the communication with the Union troops. The enemy were given no rest by the flotilla. They were frequently driven from their rifle pits, but continually returned to them with indomitable courage whenever the fire of the gunboats slacked for a moment. While Cushing was operating with his vessel, he also kept pickets on shore to present a surprise, and a party of these men captured


Map of
Nansemond River and Vicinity
showing scene of Naval Operations
in aid of army defense of Suffolk, Va.
Military lines from Army War Records Map
Union
Confederate
Statute Miles
Western Branch
Hallidays Point
NANSEMOND RIVER
Sack Point
Reed Point
Hills Pt.
Reed Yard
SEABOARD AND ROANOKE
NORFOLK AND PETERSBURG R.R.
SUFFOLK
Suffolk Junction
Fort Halleck
Deserted Camp
Suffolk and Carolina R.R.
Suffolk and Norfolk R.R.
Suffolk and Petersburg R.R.
Suffolk and Nansemond R.R.
Suffolk and Carolina Canal
Suffolk and Nansemond Canal
Suffolk and Petersburg Canal
Suffolk and Norfolk Canal
Suffolk and Carolina Road
Suffolk and Nansemond Road
Suffolk and Petersburg Road
Suffolk and Norfolk Road
DISMAL
SWAMP

the engineer-in-chief on the staff of the Confederate General French who had come down near the gunboats with the intention of locating batteries. General Peck and General Getty both relied very much on the aid of the Navy in repulsing the Confederate attack on Suffolk, and they were largely indebted to the officers and men of the vessels for the hearty co-operation which they afforded, either by scattering the enemy with their guns, or carrying the batteries on shore by assault. This latter work was done on several occasions in the most handsome manner, the assaulting party being always led by Lieutenant Lamson. General Getty, that brave old soldier, who never failed to acknowledge merit when it came under his notice, was profuse in his acknowledgments of Lieutenant Lamson's conduct. It would require too long an account to tell the whole story of this expedition, where fighting was carried on from the 12th of April to the 23d, where the sailors took their share of the fighting on shore, and where the gunboats, under the incessant fire of the enemy were nearly knocked to pieces.

U. S. FLAGSHIP "MINNESOTA," NEWPORT NEWS, VA., April 12, 1863—4 a. m.

SIR: Proceed with the *Barney* to the lower Nansemond to assist in repelling the enemy, who are surrounding Suffolk. When there, act at your discretion. I want to see you.

Respectfully yours,

S. P. LEE,

Actg. Rear-Admiral, Comdg. North Atlantic Blockading Squadron.

LIEUTENANT W. B. CUSHING, U. S. NAVY.

Commanding U. S. S. *Commodore Barney.*

U. S. S. COMMODORE BARNEY, NANSEMOND RIVER, April 12, 1863.

SIR: I am at anchor just below the obstructions. I have been up to Suffolk and communicated with General Peck and with Lieutenant Lamson.

There are two points in the lower Nansemond where the enemy would be likely to cross. I am now off one, the other is 2 or 3 miles below. The rebels have a pontoon train, and can easily bridge the river (if not closely watched) in the night. I can only guard this position, since we can not run with the *Barney* after dark.

If, as senior officer, I have command of the vessels now in the river, I will take one from above and station it at the point below me, mentioned by General Peck. If the enemy make a fair attack in front, without attempting to cross the river, am I at liberty to lighten my vessel so as to cross the bar? At high water I can get over in 7 feet water, and then there is deep water all the way up.

If it comes to a fight, it will be a hard task to remain at anchor within sound of rebel cannon.

I am, sir, very respectfully, your obedient servant,

WM. B. CUSHING,

Lieutenant, Commanding.

ACTING REAR-ADMIRAL S. P. LEE,

Commanding North Atlantic Blockading Squadron.

U. S. S. "COMMODORE BARNEY," NANSEMOND RIVER,
April 13—4.20 p. m.

SIR: I send a boy who deserted from the rebels day before yesterday. He has been closely questioned by me, and I am far from satisfied with his story. He first said that the Confederates took him from Petersburg day before yesterday. After a time he made the time three weeks. First said that he ran away 5 miles from Suffolk; next, that he was at the time only 2 miles from Petersburg, and finally that he ran away at both places. He once denied that he had been near Suffolk, but evidently has. I cross-questioned him strictly, and thus made him contradict himself. He is a smart boy, and I think a spy. He wants to ship, but I do not want him here, for he would desert and go back to them with information at night.

The Confederates are trying without doubt to surround General Peck. I find that there are about 10,000 men on the left bank of the river, and these are probably the flanking force. The rest of Longstreet's force is on the right bank, in rear of Suffolk. I understand that he has some siege pieces and heavy artillery. I can and will prevent them from crossing below the barricade. Some of the Confederate cavalry was in sight this morning, and women and children came down to us for protection. I have seen no point on this river that can be called a good artillery position, and have no doubt that out light boats can retain command of the Nansemond. General Peck's fortifications are of the strongest description, and he can repulse any force of the enemy. No more vessels are needed. Lieutenant-Colonel Kimball, of the Ninth New York Zouaves, was shot dead by General Corcoran night before last. I shall seize all the boats in the river until the enemy advance or retreat. I may be wrong in my opinion of this drummer boy; you can judge better than I.

Very respectfully, your obedient servant,
WM. B. CUSHING,
Lieutenant, Commanding.

ACTING REAR-ADMIRAL S. P. LEE,
Comdg. North Atlantic Blockading Squadron, Newport News, Va.

U. S. S. FLAGSHIP "MINNESOTA," NEWPORT NEWS, VA., April 13, 1863.

SIR: Yours of this date received this evening. I am highly gratified with your opinion that you can, and your determination that you will, prevent the enemy from crossing the Nansemond below the Western Branch. The width of the river there allows the *Barney* to move about and fire, which will greatly favor your efforts; but it is in the narrow, creek-like stream above the Western Branch that the light vessels are exposed to the fire of the fieldpieces and musketry, and whilst I place confidence in the intelligence of Lieutenant Lamson and the officers and crews of the *Mount Washington, Steppping Stones, Cohasset,* and *Alert,* I do not think it prudent that General Peck should exclusively rely on the invulnerability of these vessels to protect his rear, and should remove all his artillery (as he appeared to have done by Lieutenant Lamson's letter) which he had previously provided for this purpose.

It is very flattering to have the Army rely upon the Navy, but where so great a result is at stake it is proper that the general should not make the mistake of foregoing those judicious auxiliary measures necessary to secure so important a point as the protection of his rear. I expected Lieutenant Lamson to call the general's attention to the facts of the case. I shall accept your opinion that the boy you sent this evening is a spy, and shall treat him as a prisoner for the present. Relying on your opinion of your ability to keep the enemy from crossing the lower Nansemond, I revoke my order to call the *Cohasset* from above to assist, and shall so apprise Lieutenant Lamson.

Respectfully yours,
S. P. LEE,
Acting Rear-Admiral.

LIEUTENANT W. B. CUSHING, U. S. NAVY.
Commanding U. S. S. *Commodore Barney*, Lower Nansemond River.
(A copy of this sent to Lieutenant Lamson.)

U. S. S. "COMMODORE BARNEY," NANSEMOND RIVER,
Virginia, April 14 [1863]—7.30 p. m.

SIR: This morning the vessels from above came down—the *Mont Washington* disabled. About 11.30 [a.] m. the enemy fired on us with seven pieces of artillery, giving us a cross fire. At once got underway and went into action, silencing the enemy in an hour. At about 1 p. m. the rebels took up a position within 700 yards of the *Mount Washington*, which was aground, and opened on us with both artillery and sharpshooters. I kept close to the disabled steamer, and fought the enemy until high water, when I ordered the *Stepping Stones* to take the *Mount Washington* in tow. This was done under a heavy fire. At 5 p. m. I had the satisfaction of silencing the enemy's battery. My loss foots up 3 killed and 7 wounded. I do not know as yet what the casualties are in the other vessels. I have eight raking shots, but fortunately my engine is not disabled. I can assure you that the *Barney* and her crew are still in good fighting trim, and we will beat the enemy or sink at our post. I need more ammunition for 9-inch and 6-inch guns. The worst of the wounded, and the dead, I send down to the *Minnesota*. It is only requisite to look at the *Mount Washington* to see with what desperate gallantry Lieutenant Lamson fought his vessel. I am now taking in coal and shall anchor for the night where we have fought all day.

I am, sir, very respectfully, your obedient servant,
WM. B. CUSHING,
Lieutenant, Commanding.

ACTING REAR-ADMIRAL S. P. LEE,
Commanding North Atlantic Blockading Squadron.

EXTRACT OF A LETTER FROM LIEUTENANT CUSHING TO HIS MOTHER.

U. S. S. "COMMODORE BARNEY," NANSEMOND RIVER,
9 p. m., April 15, 1863.

MY DEAR MOTHER: Another fight and another victory! Again I have passed through the ordeal of fire and blood, and again I thank God for

being safe in life and limb. Suffolk is besieged by the enemy, thirty thousand strong, and contains an army of fifteen thousand to defend it. The town is situated on this river, and its water communication must remain open or our force will be in a desperate position. Who do you suppose was selected to perform the dangerous task of guarding the rear and preventing the crossing of ten thousand of the flower of the Southern army? Who but your son! That ex-midshipman, ex-master's mate, hair-brained, scapegrace, Will Cushing! Yes, it is even so, I am senior officer, commanding in the Nansemond River. I have my vessel and two others now. I had two more, but they were disabled in action, and have been towed to Hampton Roads. I am six miles from the city, at a placed called Western Branch, the point most desired by the enemy. I draw too much water to go up further, but send my light boats up above. Yesterday morning, as they were on their way down, they encountered a battery at a distance of three hundred yards, and swarms of riflemen in the bushes on the banks. A sharp action ensued, in which two of the boats were disabled, and but one left uninjured, but the captain of her, like a brave fellow as he is, got them around the point out of range and we managed to get them as far as the bar here, when one, the *Mount Washington*, got aground. The rebels soon appeared in force, bent upon driving us and crossing the river. They opened with artillery from two positions, a cross fire, and their seven pieces sent a hail of shot and shell around us. I had but two vessels afloat, but I silenced their fire in an hour. In a short time they again went into action; this time unmasking a regularly constructed battery not five hundred yards from us, and so situated as to rake the narrow channel completely. It was impossible to get our disabled steamer off from the bar until high water, five hours ahead, and I determined to fight on the spot as long as the *Barney* was above the water. I sent the light steamer down to guard another coveted point, and was soon exchanging death calls with the enemy.

Well, it was a hard fight, and at close quarters most of the time; so close that their infantry riddled the two vessels with bullets. *Crash!* go the bulkheads—a rifle shell was exploded on our deck, tearing flesh and woodwork. A crash like thunder is our reply—and our heavy shell makes music in the air, and explodes among our traitor neighbors with a dull sullen roar of defiance. Up goes the battle flag, and at once the air is filled with the smoke of furious battle, and the ear thrills with the unceasing shriek and whistle of all the shell and rifle bolts that sinful man has devised to murder his fellow-creatures. *Crash! Crash!* Splinters are flying in the air; great pools of blood are on the deck, and the first sharp cry of wounded men in agony rises upon the soft spring air. The *dead* cannot speak—but there they lie motionless, lifeless, and mangled, who a moment ago smiled on the old flag that floated over them, and fought for its glory and its honor. Sprinkle ashes over the slippery deck—the work must still go on. The rifled gun—my best—is disabled; for three shots have struck it—the muzzle is gone, the elevator is carried away, and the carriage is broken. Steady, men, steady! Fill up the places of the killed and wounded—don't throw a shot away. The wheel of the howitzer is torn off by the shell, and the gun rendered useless—never mind! Work the remaining guns *with a will* —for we can and *must* be victorious. And so the time wore away, until

the rising river promised to release the imprisoned steamer, when I signaled to the light steamer to move up and take her in tow. This duty was gallantly performed and the old *Barney* remained alone under the rebel cannon.

And here let me pause to give credit to one who will never earn more glory than he grasped in our desperate combat then. Lieutenant Lamson is one of the class below me, and commanded the disabled steamer *Mount Washington*. When his vessel was aground on the bar he fought her with the most determined and desperate courage. Not heeding the iron storm that was fast destroying his command, he answered gun for gun the enemy's fire, and came out of the five hours fight with torn planks and leaking timbers, but covered with glory. I fought within a hundred yards of him and we are sworn friends for life. Well I silenced the battery, and anchored at night where I had fought all day, at my post.

My vessel is riddled with cannon balls and bullets, and I have lost three killed and nine wounded—four of them mortally—men who lost legs and arms. The loss on the other vessels is proportionately severe. I am no braggart, but I challenge the world to furnish a more determined fight, or a victory more richly earned. The enemy *shall* not *cross* here. I will not give way one inch. Even now the thickets on the banks are alive with their sharpshooters; and as I write the quick whirr of the riflet bullet is often heard, sent from the banks five hundred yards ahead, in the vain hope of injuring the hated Yankee. A good providence seems to watch over my fortunes, though I do not deserve its protection. I may go into action again at any moment, probably to-morrow.

U. S. S. "COMMODORE BARNEY," NANSEMOND RIVER, WESTERN BRANCH,
April 17 (1863)—9 p. m.

SIR: At high water this morning I started the *Alert*, *Coeur de Lion*, and *Teaser* up the river. The *Alert* passed up safely, but the *Teaser* and *Coeur de Lion* grounded. I got the first named of the two off an hour or two ago; the second got off before noon and was sent up the river this evening. The *Teaser* has in some way disabled the engine, and I am forced to send her down. I shall order the *Yankee* up at 9 in the morning, though I think it dangerous to do so, since she cannot be guided by the helm when in the mud. We will lighten her as much as possible, and if she goes ashore under the fire of the battery I will protect her as much as possible. The *Primrose* cannot go up in any event, but is of the greatest importance below. I have pickets ashore on this bluff, in order that I may not be surprised by the enemy, and in order that my officers may not be picked off from the brush. This forenoon two of my men captured the engineer-in-chief on the staff of the rebel Major General French. He came down within 300 yards of the boats to make a reconnoissance, no doubt intending to locate rifle pits and batteries. He was accompanied by a citizen, armed, who made his escape. The people living in this vicinity aid the rebels in every way, and do not scruple to fire at our men. If I take one with arms in his hands trying to kill my men, I will not take him prisoner. Please bear in mind that this officer was captured below Western Branch Creek,

which fact goes to prove that General French is on duty below my position; in fact, I am aware that he dined with his staff in the village of Chuckatuck, some distance below, and from the shore I also received information that a brigade is located 3 miles inshore from Sleepy Hole, and that they are constructing a masked battery there. I have sent the *Yankee* and *Zouave* there to-night, and have stationed the *Primrose* at Bush's Point, another dangerous spot. I remain in my old position with this vessel, within 700 yards of the battery and rifle pits. The Confederates have thrown up so much earth fronting me that I can do them very little injury by my fire. Their three guns bear on a point in the channel just above the bar, and seem to be stationary. I judge so from the fact that they did not fire on the *Teaser* during the five hours that she lay helpless within 500 yards of the fort, but they fired on the *Alert* just as she reached a certain point not 50 yards from the *Teaser*, and also on the *Coeur de Lion* this evening when at the same point, and when they passed this spot the firing ceased, though they would have been for some time within range of an ordinary battery. I am confident that these are pieces that I have disabled by knocking the carriages in pieces, and that they have so placed them that they bear on one point, and have wedged them in that position. If I could get directly in their front I could break them up in fifteen minutes, but they are behind a high bank of earth and do not bear on me at all.

I am, sir, very respectfully, your obedient servant,

WM. B. CUSHING,
Lieutenant, Commanding

ACTING REAR-ADMIRAL S. P. LEE,
Comdg. North Atlantic Blockading Squadron, Newport News.

U. S. S. "COMMODORE BARNEY," NANSEMOND RIVER, WESTERN BRANCH,
April 17 (1863)—10 p. m.

SIR: There is one thing that I neglected to state in my dispatch written an hour ago. The expedition that was to capture the rifle pits failed in consequence of the army men being frightened at nothing. Two hundred men were landed by the *Stepping Stones;* they remained ashore five minutes and saw three rebel pickets running away, which so frightened them that they returned without firing a shot. If you can send me two launches with smoothbore 12-pounder howitzers or others, I will agree to capture the battery and rifle pits on the bank ahead and spike the guns. As the cannons are stationary, but few men are needed in their works, and I am confident that they can be driven out, killed, or captured by a close attack with launches in front and flank, and then a sudden land charge with about fifty men. Just after dark would be my time for attack, when the few men in the rifle pits cannot pick the men off the launches. It is important that these guns should be spiked, since every steamer going up has to pass the point on which they bear, and some must get disabled. Their position is such that the few rebels there could not get assistance in time to repel a sudden and vigorous attack. If this is not done the artillery will soon be repaired with new wheels or other disabled portions, and thus their force will regain several rifled pieces that cannot now be used in the field. That

captured engineer officer, whose name is Rogers, admits that the cars are running on the railroad. I knew that I could not be mistaken. I learn many of these points in advance of the army, and will try to give you reliable information. I shall take most of the men from the *Teaser* before sending her down, as I am short-handed in consequence of deaths, wounds, and five men lent to Captain Harris.

I am, sir, very respectfully, your obedient servant,

W. B. CUSHING,
Lieutenant, Commanding.

ACTING REAR-ADMIRAL S. P. LEE,
Comdg. North Atlantic Blockading Squadron, Newport News, Va.

(Telegram.)

SUFFOLK, April 19, 1863—8 p. m. (Received 11.30 p. m.)

General Getty landed to-day with Lieutenant Lamson, 300 men and four boat howitzers at the point of junction with Western Branch and Nansemond. Captured five pieces of artillery and 161 rebel prisoners, Forty-fourth Alabama. General Getty holds the place, intends to fortify it. Is throwing re-enforcements. He wants assistance of the gunboats for the present. I await further orders.

PIERCE CROSBY,
[Fleet] Captain.

ACTING REAR-ADMIRAL S. P. LEE,

ORDER OF ACTING REAR-ADMIRAL LEE, U. S. NAVY, TO LIEUTENANT CUSHING, U. S. NAVY, REGARDING VESSELS IN UPPER NANSEMOND.

U. S. FLAGSHIP "MINNESOTA," NEWPORT NEWS, VA.,
April 19, 1863—11.30 p. m.

SIR: Captain Crosby's dispatch from Suffolk informs me of General Getty's success. Congratulate the general for me. I willingly assist him and let the gunboats remain. He is of the right sort. I think, however, he would have done well to have shinned over to his own side for the night, as it is dark, unless he got into position in time to secure himself. At 4 a. m. I will send this in by the *Philadelphia*.. Send her back with a report of the situation and your wants, if any. If practicable send me the *Cohasset* in the morning and let the *Zouave* take her place. If we hold the battery this can easily be done. I require a tug.

Respectfully yours,

S. P. LEE,
Acting Rear-Admiral.

LIEUTENANT W. B. CUSHING, U. S. NAVY.
Comdg. *Commodore Barney*, Nansemond River.

U. S. FLAGSHIP "MINNESOTA," NEWPORT NEWS, VA., April 20, 1863.

Well done, good, faithful officers! The flotilla need not return to the upper Nansemond (the enemy being in retreat, as reported by Lieutenant

Cushing), except the *Stepping Stones*. She may resume her usual position in the river. Lieutenant Lamson may return when he sees fit. Mail is closing. In great haste.

S. P. LEE,
Acting Rear-Admiral.

LIEUTENANTS CUSHING and LAMSON.

U. S. S. "COMMODORE BARNEY," WESTERN BRANCH NANSEMOND RIVER,
April 20 (1863)—8 a. m.

SIR: Another battery, heavier than the first, has been unmasked by the enemy. I engaged it yesterday, until I was taken in the flank at close quarters by a sharp fire of musketry across our decks. I drove them from the woods and again engaged the battery while our force was in sight taking the fort. My loss was one man mortally wounded, who died last night, and whose body I send to the *Philadelphia*. This vessel was struck but once (in the hull) by shell, though they burst all around at a distance of 20 yards either side. Unlike their firing of the 14th, their shell now burst with great precision. The pieces in this battery are all rifled, as were those on the captured point on the day we engaged it. One is a 50 or 100 pounder rifled, and the others are from 20s to 12s. It is so masked that I have only their smoke to fire at. I engage it to-day at 12 m., and if I do not get a shot in my exposed magazine shall hope to silence it before night. I shall extend your congratulations to Lieutenant Lamson (as well as General Getty), to whom all the credit is due for yesterday's gallant exploit—the capture of the battery in our front.

I am, sir, very respectfully, your obedient servant,

WM. B. CUSHING,
Lieutenant, Commanding.

ACTING REAR-ADMIRAL S. P. LEE,
Commanding North Atlantic Blockading Squadron.

U. S. S. "COMMODORE BARNEY," NANSEMOND RIVER, WESTERN BRANCH,
April 21, 1863—1.35 a. m.

SIR: When I said yesterday that the enemy had withdrawn from our front I intended to convey the idea that the battery that I was going to engage had been abandoned during the night. I might have added that I had every reason to believe that the whole rebel army is in retreat. My opinion coincided with that of General Getty. Last night our troops evacuated the fort in my front by order of General Peck. I protested against an act that would close the river if the enemy were in earnest; but the rebel pickets now hold it. Our land force fortified it strongly in the rear and left their works for the rebels to use. I do not see how such a movement can be justified. You are mistaken in believing the captured guns to be the ones used against us on the 14th. They (those used then) were rifled guns, and we have some of their shell on board. We disabled that battery and it was replaced by this. I confess that when I looked at

the works and saw their great strength I was astonished that we silenced them on that day. I think that active work is nearly over in this quarter.

I am, sir, very respectfully, your obedient servant,

WM. B. CUSHING,
Lieutenant, Commanding.

ACTING REAR-ADMIRAL S. P. LEE,
Commanding North Atlantic Blockading Squadron.

U. S. S. "COMMODORE BARNEY," SLEEPY HOLE, NANSEMOND RIVER,
April 23, 1863—12 a. m.

SIR: I have the honor to report that on the 21st I received information from Captain Harris, of the *Stepping Stones*, then anchored at this station, that a boat's crew of five men had been killed or captured by the enemy under the following named circumstances: At 11 a. m. on that day a white handkerchief was waved on the rebel shore by a man dressed in citizen's clothes, and thinking the person to be a Mr. Wilson, and wishing to gain information as to the state of the country, Captain Harris sent in a boat containing five men to bring him off. As soon as the boat reached the beach it was fired upon by persons concealed in the brush. The fire was returned from the boat and the *Stepping Stones* opened from her howitzers. Upon learning of this treacherous act, I determined to so punish it that we should not suffer so in future. On the morning of the 22d we moved down from Western Branch with the *Yankee* in company and anchored near the *Stepping Stones*. I at once proceeded to organize a boat expedition, and at 1.45 p. m. seven boats left the side of the *Barney*, two belonging to that vessel, three from the *Yankee*, and two from the *West End* (army boat). The crews were made up of details from the several vessels present and numbered about ninety men. We pulled in boats in line abreast and covered by the fire of the boats, and landed the men and one 12-pounder howitzer. The boat sent in the day before was secured, together with four muskets and the dead body of Rietchurch, seaman of *Minnesota*.

Leaving a party to guard the boats, I advanced and, throwing out a line of skirmishers in front, burned three houses, with barns, etc., owned by men who had given active service to the rebel cause while wearing the dress of private citizens. All the buildings were on the point of land from which the enemy fired on the 21st.

As soon as this was done our force advanced on Chuchatuck village, 3 miles distant, at which point 400 cavalry were said to be posted. We came upon their pickets about a mile and a half from the town and drove them in, and, having secured a mule cart, toggled the trail rope of the howitzer to the rear and went forward at a double-quick. My object was, if possible, to re-capture our men and to punish the rebels for their cowardly conduct. Two other squads of their pickets were driven in, and at 4.30 we entered the town. Suddenly a party of cavalry, numbering about forty men, appeared some 200 yards in our front, coming down the street at a saber charge. The howitzer was at once unlimbered and discharged, and my men opened with musketry. At this the mules became frightened

and charged directly into the rebel ranks, taking with them the most of our howitzer ammunition. As soon as the gun was discharged our sailors went forward with a cheer, drove the enemy, and repossessed themselves of the cart and ammunition.

The rebels retreated with the loss of two killed and three horses, fully equipped, captured; also six cavalry pistols. We remained masters of the town. Finding that the captured sailors had been taken to the Confederate headquarters across Reed's Ferry, I started for the river at 5.15 p. m. and reached the boats safely at 7, having a slight skirmish by the way. I lost one man killed in the cavalry charge (Daniel Conlow, landman), who, being slightly in advance, fired right in the face of the advancing force and was shot in two places. I send his body by the *Coeur de Lion*, as also the corpse of the man killed on the 21st. This has been a most important reconnoissance, and has, I think, demonstrated that the rebels are not in strong force near Suffolk. I shall communicate the result to General Peck at once. Acting Master's Mate, James Birtwistle, of the *Minnesota*, behaved as usual with the coolest bravery in working the howitzer, and certainly deserves promotion if gallantry and strict attention to duty merit such reward. Acting Ensign William Hunter had charge of the advance guard, and did his whole duty. Acting Master's Mate G. M. Lawrence, of the *Stepping Stones*, acting as guide, and may justly claim great credit for his share in the expedition. Master's Mate Aspinwall took charge of the boats, and took all citizens near prisoners, in order that no information of our movements might be taken to the enemy. Acting Master's Mate Borden, from the *Yankee*, took charge of the main body under myself, and did his duty. When I entered the town I had with me about half of the men, as I had to leave a force at the crossroads to protect my rear. I cannot refrain from drawing a contrast between the conduct of the sailors, who behaved most nobly, with that of the fifteen soldiers from the *West End*, whom I was obliged to threaten in order to make them do their duty.

I am, sir, very respectfully, your obedient servant,

W. B. CUSHING,
Lieutenant and Senior Officer in Nansemond.

ACTING REAR-ADMIRAL S. P. LEE,
Comdg. North Atlantic Blockading Squadron, Newport News, Va.

NAVY DEPARTMENT, April 24, 1863.

SIR: I have received your despatch No. 448, with the enclosures. The course pursued by you, as disclosed by your orders to Lieutenants Cushing and Lamson and your correspondence with Major-General Dix, was judicious and is approved by the Department.

Great credit is due Lieutenants Cushing and Lamson and their commands for the courage, skill, and energy displayed by them and their officers and men in an emergency requiring the exercise of undaunted bravery and resolution. The naval forces have well sustained themselves in the trying circumstances in which they have been placed and borne themselves in a manner deserving commendation. It is to be regretted that the battery which they captured, and which was the key of the

position above, should have been abandoned, unless under compulsory necessity. You have every reason to be satisfied with your own course, and also with that portion of your command which participated in these conflicts and so faithfully executed your orders.

Very respectfully, etc.,

GIDEON WELLES,
Secretary of the Navy.

ACTING REAR-ADMIRAL S. P. LEE,
Comdg. North Atlantic Blockading Squadron, Old Point Comfort.

U. S. FLAGSHIP "MINNESOTA," off NEWPORT NEWS, VA.,
April 25, 1863.

SIR: I beg leave to enclose for the information of the Department certified copies of the several reports by Lieutenants W. B. Cushing and R. H. Lamson respecting our operations in the lower and upper Nansemond during the recent demonstration of the enemy against Suffolk.

The Department will perceive on perusal of these interesting narratives that these young officers, in the extremely difficult and hazardous positions in which they have been placed, have exhibited remarkable zeal, courage, and discretion, and that the officers and men under their command have faithfully and gallantly supported them.

I hope the Department will also especially notice Lieutenant Cushing's gallantry and enterprise in conducting an important armed reconnoissance with ninety men from the gunboats and a 12-pounder howitzer, 3 miles into the enemy's country to Chuckatuck village, where a force of cavalry was put to flight and a safe return to the gunboats effected after a brief occupation of the town.

I have the honor to be, sir, very respectfully yours,

S. P. LEE,
Actg. Rear-Admiral, Comdg. North Atlantic Blockading Squadron.

HON. GIDEON WELLES,
Secretary of the Navy, Washington, D. C.

NAVY DEPARTMENT, May 4, 1863.

SIR: Your gallantry and meritorious services during the recent demonstration of the enemy upon the Nansemond and in co-operating with the army are entitled to the especial notice and commendation of the Department. Your conduct on this occasion adds additional luster to the character you have already established for valor in the face of the enemy.

The energy and ability displayed by yourself and the officers and men under your command in the defense of the the lower Nansemond are most creditable and are appreciated by the Department.

The Department desires to express to you more especially its admiration of your gallantry and enterprise in conducting an important armed reconnoisance with a party from the gunboats some miles into the enemy's country to the village of Chuckatuck and putting to flight a body of rebel cavalry and safely returning to your vessel.

Accept my congratulations for yourself and the officers and men that were under your command.

Very respectfully, etc.,

GIDEON WELLES,
Secretary of the Navy.

LIEUTENANT W. B. CUSHING, U. S. NAVY.
Commanding U. S. S. *Commodore Barney*, Old Point Comfort.

SUFFOLK, VA., May 5, 1863.

COLONEL: . . . On the 14th Lieutenant Cushing, U. S. Navy, was hotly engaged for several hours with a large force at the mouth of the Western Branch. His loss was severe, but the enemy suffered much and had some artillery dismounted. The enemy opened a 10-gun battery near the Norfleet house for the purpose of destroying the gunboats and of covering a crossing. Lieutenant Lamson, with the *Mount Washington, West End,* and *Stepping Stones,* engaged the battery for some hours in the most gallant manner, but was compelled to drop down to the Western Branch. The *Mount Washington,* completely riddled and disabled, grounded, as did the *West End,* and both were towed off by the *Stepping Stones.* The rudder of the *Alert* was broken.

General French's engineer was taken prisoner by Lieutenant Cushing's pickets. He was laying out works and had a map of Suffolk, which he tore to pieces.

On the 18th the enemy was very active in throwing up new batteries and rifle pits along the river. A heavy one was in progress near the mouth of Western Branch on Hill's Point. Admiral Lee, U. S. Navy, ordered all the boats out of the upper Nansemond, lest they should be destroyed, leaving the whole defense of the river to the land forces. The admiral was urged to reconsider his orders. Upon my representation the order was temporarily suspended.

May 4.—About 9 p. m. on the 3d the enemy commenced retiring upon the Blackwater. His strong line of pickets prevented deserters and contrabands from getting through with the information until he had several hours the start.

Thus ends the present investment or siege of Suffolk, which had for its object the recovery of the whole country south of the James, extending to the Albemarle Sound in North Carolina, the ports of Norfolk and Portsmouth, 80 miles of new railroad iron, the equipments of two roads, and the capture of all the United States forces and property, with some thousands of contrabands.

The co-operation of the gunboats, under Lieutentants Cushing, Lamson, and Harris, U. S. Navy, sent by Admiral Lee, has been very effective and I take great pleasure in acknowledging the gallant services of their officers and crew. Very respectfully, your obedient servant,

JOHN J. PECK,
Major-General.

COLONEL D. T. VAN BUREN,
Assistant Adjutant-General, Department of Virginia.

REPORT OF LIEUTENANT CUSHING, U. S. NAVY, COMMANDING U. S. S. "SHOKOKON," REGARDING THE DESTRUCTION OF THE "HEBE."

U. S. S. "SHOKOKON," off WILMINGTON, N. C., August 24, 1863.

SIR: I have the honor to report that early on the morning of the 18th I discovered a steamer ashore about 8 miles to the northward of Fort Fisher. Stood in and found to to be the Anglo-rebel steamer *Hebe*. She was on the beach, and the gunboat *Niphon* was near, making preparations to board her. One of the *Niphon's* boats succeeded in going alongside, but was stove, leaving the crew on the deck of the prize. It was blowing a gale from the northeast, making it a lee shore for us, and in the heavy sea two more boats belonging to the *Niphon* were swamped and their crews either shot, drowned, or taken prisoners by the enemy, who kept up a constant fire from infantry and artillery. I now sent a boat in and succeeded in rescuing two of the *Niphon's* men.

After throwing a shell into the *Hebe* forward to warn the three men left on her deck to leave her, and having seen them reach the beach, we commenced a heavy fire, that soon riddled her. Twice she was on fire from our shells, and twice the sea extinguished the flames, but just after a shell exploded abaft the smokestack her decks blazed up and continued to burn until she was a wreck. Our fire was kept up at from 100 to 300 yards' range. The rebel artillery was used against us about four hours, but all their shell passed over us and did no injury. The vessel was somewhat marked by musket bullets.

I am, sir, very respectfully, your obedient servant,

W. B. CUSHING,
Lieutenant, Commanding.

ACTING REAR-ADMIRAL S. P. LEE,
Commanding North Atlantic Blockading Squadron.

DESTRUCTION OF THE BLOCKADE RUNNER "ALEXANDER COOPER."

U. S. FLAGSHIP "MINNESOTA," off WILMINGTON, N. C.
August 28, 1863.

SIR: I transmit enclosed the interesting report of Lieutenant Cushing respecting the destruction of the blockade running schooner *Alexander Cooper*, in New Topsail Inlet, on the 22d instant.

Lieutenant Cushing had previously communicated his plan to me and received my authority for undertaking it. This was a handsome affair, showing skill and gallantry. I regret that the contrabands who, under orders, assisted our little band, and thereby were compromised, could not have been brought off.

I recommend Mr. Cony for promotion to acting master and approve of Lieutenant Cushing's recommendation to promote Robert [T.] Clifford to master's mate.

I have the honor to be, very respectfully,

S. P. LEE,
Actg. Rear-Admiral, Comdg. North Atlantic Blockading Squadron.

HON. GIDEON WELLES,
Secretary of the Navy, Washington, D. C.

(Endorsement.)

Give Clifford a medal and promote to acting master's mate; appointed September 7. Promote Cony; promoted September 7.

(Enclosure.)

U. S. S. "SHOKOKON," off WILMINGTON, N. C., August 25, 1863.

SIR: I have the honor to report that we have destroyed the blockade running schooner *Alexander Cooper* under the following circumstances:

On the 12th I made a reconnoisance with boats in New Topsail Inlet and was driven out by the fire of four pieces of rebel artillery stationed opposite the mouth, but not before I had discovered a schooner at a wharf some 6 miles up the sound. This schooner I determined to destroy, and as it was so well guarded I concluded to use strategy. On the evening of the 22d the *Shokokon* anchored close into the sea beach about 5 miles from the inlet and I sent ashore two boat's crews, who shouldered the dingey and carried it across the neck of land that divides the sea from the sound. This was about half a mile in width and covered with a dense thicket. The crossing placed my men some miles in the rear of the artillery force guarding the entrance. The dingey being launched on the inside waters, 6 men, under my executive officer, Acting Ensign Jos. S. Cony, started with orders to destroy or capture anything that could be of use to the enemy. Now, it seems that a 12-pounder howitzer was stationed at the point from which we were aiming, and the smokestack of my steamer having been seen over the trees, the commandant of the post, Captain Adams, had come down from the main camp to insure a bright lookout.

While the rebels at the schooner's mastheads were straining their eyes in looking to the southward, my boat was approaching in the other direction, and the men succeeded in landing about 50 yards from the wharf, without being discovered. The master-at-arms, Robert Clifford, crept into the rebel camp and counted the men, and having returned to his shipmates, a charge was ordered, and our 7 men bore down on them with a shout. In a moment the enemy, who outnumbered us 3 to 1, were routed, leaving in Mr. Cony's possession 10 prisoners, including Captain Adams and Lieutenant Latham, one 12-pounder army howitzer, 18 horses, 1 schooner, and some extensive salt works.

Mr. Cony then threw out two pickets, detailed two men to guard the prisoners, and with the remaining 2, fired the vessel and salt works; these were thoroughly consumed.

The object of the expedition being accomplished, my men returned to this vessel without loss, bringing with them 3 of the prisoners, all that the boat would contain.

The rebel officers and privates were dressed alike, and Mr. Cony was at a loss to know what three to retain. He settled the matter, however, by picking out the three best looking ones, who all turned out to be privates. So the officers owed their safety to their lack of physique, a new feature in military strategy.

While this was going on at the mainland, my pickets on the beach side, under Acting Master's Mate Proudfit, engaged and repulsed the rebel picket force in that quarter without loss on our side. The manner in which my

orders were carried out is highly creditable to Mr. Cony, who is, I beg leave to state, a good officer, seaman, artillerist, and navigator. The names of the men who made this daring charge are: Robert T. Clifford, master-at-arms; James Wallingford, captain forecastle; Henry Mansfield, coxswain; Herman P. Loss, Edward Brett, Henry Vonversen, ordinary seamen.

Clifford has volunteered upon no less than four occasions of danger since I have been aboard and never fails to do his duty. He is qualified for promotion to master's mate. All are good men.

This schooner cleared from New York for Port Royal, S. C., with an assorted cargo, and was towed once outside the line of blockade by a gunboat. I shall try to learn the names of the patriotic citizens of my State who entered into this little speculation.

I am, sir, very respectfully, your obedient servant,

W. B. CUSHING,
Lieutenant, Commanding.

ACTING REAR-ADMIRAL S. P. LEE,
Comdg. North Atlantic Blockading Squadron, off Wilmington, N. C.

Admiral Porter wrote of this event:

The object of the expedition having been accomplished, the men returned to their vessel, taking with them three prisoners, all that the boat would hold. The Confederate officers and men were all dressed alike, and Mr. Cony could not tell them apart, so he was at a loss to know which to retain. He settled the matter by picking out the three best looking, who all turned out to be privates.

This performance almost sounds like romance, but Cushing's officers were all animated with his spirit, and were always ready to undertake anything, no matter how hazardous. As many risks were run, and as many dangers faced, as fell to Decatur's lot when he cut out the *Philadelphia* in Tripoli harbor.

Cushing's cool account of testing an old river steamer in a severe gale at sea met with the approval of his squadron commander. This test was made under the eye of Rear-Admiral Lee.

U. S. FLAGSHIP "MINNESOTA," off WILMINGTON, N. C., August 28, 1863.

SIR: I enclose the report of Lieutenant William B. Cushing, commanding the U. S. S. *Shokokon*, of this date, from which, and the verbal reports of that zealous and able young officer, it appears that the *Shokokon* was near being lost in the severe gale of yesterday. The gale backed from the East to N. N. W., and blew a hurricane for nearly four hours.

I send the *Shokokon* to Hampton Roads, and have authorized Lieutenant Cushing to report in person to the Department, in the belief that the Department will cheerfully assign him to a swift and staunch steamer and immediately return him to my command for present duty on the blockade of Wilmington. I have the honor to be, very respectfully,

S. P. LEE,
Actg. Rear-Admiral, Comdg. North Atlantic Blockading Squadron.

HON. GIDEON WELLES,
Secretary of the Navy, Washington, D. C.

(Endorsement.)

This vessel (*Shokokon*) was the new *Clifton*, purchased from Mr. Law, and similar to the *Clifton*, now in the service. Length, 181 feet; beam, 32 feet; hold, 13 feet.

JOHN LENTHALL.

(Enclosure.)

U. S. S. "SHOKOKON," off WILMINGTON, N. C., August 28, 1863.

SIR: I have the honor to report that, having tested this vessel's sea-going qualities in a gale of wind, I do not deem her fit for blockading service. In yesterday's blow I just managed to get her to the anchorage under the lee of Frying Pan Shoals, and it is my opinion that if she had been 10 miles farther off land she would have gone down.

Her condition at present is as follows: Sponsons torn off or crushed, forward decks started and seams opened, forward ports carried away, and sternpost split. During the gale her wood ends opened about half an inch. She now leaks to the extent of 450 gallons a minute. When struck by a sea forward she seemed to give and bend like india rubber. This I judge to be caused by a weakness of the beams, they not being sufficiently set by knees.

I am, sir, very respectfully, your obedient servant,

W. B. CUSHING,
Lieutenant, Commanding.

ACTING REAR-ADMIRAL S. P. LEE,
Comdg. North Atlantic Blockading Squadron, off Wilmington, N. C.

NAVY DEPARTMENT, October 19, 1863.

SIR: Proceed to Hampton Roads, Virginia, with the U. S. S. *Monticello* and report to Acting Rear-Admiral Lee for duty in the North Atlantic Blockading Squadron.

Very respectfully, etc.,

GIDEON WELLES,
Secretary of the Navy.

LIEUTENANT WILLIAM B. CUSHING,
Commanding U. S. S. *Monticello*, Philadelphia.

The little *Monticello* under Cushing was on blockade duty and performed that onerous service with credit. During a shifting of the blockading vessels the *Monticello* collided with and sunk the U. S. S. Peterhoff, formerly as a blockade-runner famous in international law cases. For this Cushing was exonerated and the officer-of-the-deck held blameworthy. The blockade of the Confederate coast in the Civil War has never been fully brought

before the public. The blockade of Wilmington was specially hazardous. The town is on Cape Fear River about twenty-seven miles from its mouth. There were two mouths, New Inlet to the eastward and Western Bar Channel 6 miles to the South'ard. Between the two mouths lay Smith's Island with its southern extremity, Cape Fear projecting to seaward and continuing as a shoal ten or twelve miles, making the outside distance between the entrances nearly forty miles. The only protection against gales was to be found in the lee of Frying Pan Shoals, and at the lower mouth near the heavy guns of Fort Caswell. At New Inlet were the heavy fortifications of Fort Fisher that commanded the channel

U. S. S. "MONTICELLO."

and ocean front from well above Federal Point to Caroline Shoals below the Inlet. This great fortress was constructed and commanded by an able, zealous and gallant soldier, Colonel William Lamb, C. S. A., and it was the scene of a desperate conflict in the later days of the war when its capture by the navy and army closed Wilmington as a Confederate port. Smithville, a small town above Fort Caswell was the point of departure of blockade-runners. Dropping down from Wilmington they could here wait their opportunity to proceed to sea by either entrance, aided by the range-lights, channel boats, and at the most favorable moment. Each of the blockading squadrons at New Inlet and Western Bar, obliged in daylight to keep out of range of Fort Fisher and Fort

Caswell, respectively, were stationed in a curve with extremities nearer shore. The forts were vigilant, and if a blockader ventured within range a rifle shell gave warning to keep his distance. At night the blockaders were pressed closer in and were withdrawn at dawn to their daylight stations. The blockade runners would make the land near night-fall, and with growing darkness would dash full-speed through the fleet, and in a few minutes would be safe from capture under the protection of the guns of the fort. Here blockade-running was at its height in 1863 and 1864, and many rich cargoes passed to and from the Confederacy. The blockader's life was a hard one. To the seaward was the broad ocean, its blighting gales and tumbling billows. To the leeward a flat shore of sand and shoal, high-power guns and high-grade gunners. To the dread of a lee shore and its breakers and its forts was added the fear of loathsome prison life and prison fare for the survivors if a blockader should go ashore. In this bitter service the flower of our navy kept watch night and day, for weeks and months and years. Here, at Wilmington, Cushing with his usual energy and enterprise kept guard and here he performed, in February and June, 1864, two daring exploits that gained him wide fame. The stern patriarch at Washington expressed his gratification and gave that faint praise which has sometimes marked his lack of appreciation of his junior officers. In his "Diary," recently published, there is one mention of Cushing, viz: that President Lincoln laughed heartily over the mock monitor employed by Cushing in Cape Fear River.

Cushing's boat expedition of February 29, 1864, into Smithfield, N. C., the armed camp of the enemy, to capture the commanding general, was a dashing success that thrills the heart. To enter this armed camp of a regiment, visit its headquarters and capture the senior officer present appears so audacious that one can hardly believe that it was successfully done by a youngster of twenty-one. The absence of the Confederate general was that officer's good fortune and in no wise lessens the credit due to Cushing for his bravery.

BOAT EXPEDITION TO SMITHVILLE, N. C., FOR THE PURPOSE OF CAPTURING THE COMMANDING GENERAL, FEBRUARY 29, 1864.

Report of Lieut. Cushing, U. S. Navy.

U. S. S. "MONTICELLO," off WILMINGTON, N. C., March 5, 1864.

SIR: I have the honor to report that I passed the forts at the entrance to this harbor with two boats and 20 men on the night of the 29th of

February, and proceeded up the river to Smithville. My object was to land at that town and capture the commanding general, and to board any vessels that might be found at anchor.

I succeeded in landing directly in front of the hotel, hid my men under the bank, captured some negroes at work in a salt works, and thus gained such information as desired. Then, leaving most of the men to guard the boats, I proceeded with Acting Ensign J. E. Jones and Acting Master's Mate W. L. Howorth and one seaman to General Hébert's headquarters (situated across the street from the barracks, containing about 1000 men). I effected an entry and captured the chief engineer of these defenses, but found that the general had gone to Wilmington the same day. The adjutant-general escaped from the door after severely wounding his hand, but thinking that a mutiny was in progress, took to the woods with a great scarcity of clothing, and neglected to turn out the garrison. My boat was about 50 yards from the Smithville fort, and not so far from the sentinel on the wharf, but I succeeded in bringing my prisoner off so quietly that they did not discover me. The signal lights were made so tardily that I was abreast of Fort Caswell before they knew that boats were in the harbor, and they did not get a shot at us. The papers captured were unimportant. The *Scotia* ran out just before I reached the anchorage, so I did not have the pleasure of calling on her captain. I send Captain Kelly, C. S. Army, to you, deeply regretting that the general was not in when I called.

I am, sir, very respectfully, your obedient servant,

W. B. CUSHING,
Lieutenant, Commanding.

ACTING REAR-ADMIRAL S. P. LEE,
Comdg. North Atlantic Blockading Squadron, Hampton Roads.
I brought off the negroes captured.

ABSTRACT LOG OF THE U. S. S. "MONTICELLO," LIEUTENANT CUSHING, U. S. NAVY, COMMANDING, FEBRUARY 28, 1864.

February 28, 1864.—At 4.15 p. m. captain returned on board. At 4.36 got underway. At 4.45 the rebels opened fire upon the ship from the beach on Smith's Island. Returned their fire with 100-pounder and 30-pounder rifles. At extreme elevation our shell all fell short, while several shots of the enemy passed over the ship. Steamed slowly to southward and westward. 6 to 8 p. m.: Steaming to our station. At 6.45 came to anchor. Got gig and first (cutter) prepared for an expedition. At 7.45 first cutter, in charge of Acting Master's Mate W. L. Howorth, was sent in reconnoitering near the shore, watching the channel. 8 to midnight: At 10 the picket boat sent up a rocket, indicating a vessel attempting to run the blockade. Got underway and sighted a steamer and challenged her with two flashes of white light and a red light steady, which was answered by one flash of red-white steady. Not discovering at 11.45, returned to an anchorage. At 11.45 Acting Master's Mate Howorth left the ship in the dingey on picket duty.

February 29.—At 2. a. m. the dingey, in charge of acting master's mate, returned. At 5 got under way and started for the flagship; came to anchor

and scrubbed decks. At 9.20 flagship made signals. At 10 beat to quarters and exercised first and second divisions. At 10.20 beat retreat. Watch employed in spreading boarding netting, cleaning boats, and scraping guns. 4 to 6 p. m: Captain went on board flagship. At 5 p. m. got underway and steamed down to flagship. At 5.30 captain returned on board and we steamed for our station. 6 to 8 p. m.: At 7.15 came to anchor, 4½ fathoms. During the watch got the arms in gig and first cutter. 8 to midnight: At 8.40 p. m. Captain Cushing left the ship in gig, accompanied by Acting Master's Mate W. L. Howorth, and first cutter, in charge of Acting Ensign J. E. Jones, accompanied by (Acting) Second Assistant Engineer Martine, and started for the harbor, with the intention of going to Smithville and capturing the commanding general, Hébert.

March 1.—At 3.25 a. m. gig and first cutter returned, having succeeded in reaching Smithville and landing in safely, capturing 2 contrabands from the salt works and gaining information. We surrounded the general's headquarters and captured Captain Kelly, C. S. Army, chief engineer of the works, the general being absent, having gone to Wilmington the day before. Adjutant-General Hardeman barely escaped capture. Brought the captain and contrabands safely on board. At 5 got underway and steamed offshore to the flagship. At 5.40 came to anchor near the flagship. 8 to meridian: Quarters for inspection 9.30. At 11.30 got underway and ran in toward Fort Caswell with a flag of truce. At 12.30 p. m. first cutter left the ship under a flag of truce, Ensigns Pettit and Jones as flag-of-truce officers. Watch employed spreading boarding nettings.

CONFIDENTIAL LETTER FROM ACTING REAR-ADMIRAL LEE, U. S. NAVY, TO THE ASSISTANT SECRETARY OF THE NAVY, REGARDING GENERAL MATTERS.

(Confidential.) U. S. S. "MINNESOTA," April 4, 1864.

SIR: Yours of the 1st instant came today. Undoubtedly ironclads and some other vessels must be needed here for the approaching campaign.

Should not ironclads for the Gulf be sent either from the Mississippi River or Charleston?

We return to the Army sailors who cannot pass the examination. I thank you heartily for the promise of more vessels for Wilmington when you get seamen now to come promptly from the Army.

You say what a pity that Cushing's undaunted bravery and good luck cannot be put to a useful purpose in a manner to tell upon the enemy. Please explain this. I have always encouraged his dash, and am ever ready to do so. What can he now do? He is urging me to let him cruise off for prizes. He went into Cape Fear River to get prizes. I am rejoiced that he returned with such eclat to the *Monticello*. Pity he did not get a prize then. Well, very well, that the enemy did not get a chance to surprise the *Monticello* by returning in her boats.

He thinks that the fort on Bald Head may be surprised by the blockaders. Will you in any manner, even by a "Go to Ned" (after the fashion of the Attorney and Lord Codrington), justify the attempt? The idea is taking and the thing is possible, though Nelson failed in such an effort. But I

like enterprises, and have always encouraged them. Is this what you hint at?

I have a good idea of, and good feeling for this youngster.

Give me your mind in the matter.

The Richmond ironclads are designed to act between Drewry's Bluff and the city. If you will give the right means for the James River route to Richmond, it can and will be taken. It is now the time to do this big thing. Jo Johnston's report, which General Grant tells me he believes is entirely true, shows the weakness of the rebels. The upper James is the point for naval co-operation, and now is the time.

Respectfully yours,

S. P. LEE,

HON. G. V. Fox,
Assistant Secretary of the Navy.

CONFIDENTIAL LETTER FROM THE ASSISTANT SECRETARY OF THE NAVY TO ACTING REAR-ADMIRAL LEE, U. S. NAVY, REGARDING CUTTING-OUT EXPEDITIONS.

WASHINGTON, April 8, 1864.

ADMIRAL: I have yours of the 4th instant. Porter tells us that not an ironclad he has is fit to be out of the river, and at Charleston they might possibly spare two on an emergency. The duty there is terrible; gales continually, and torpedo boats. Few people dream of the effort required to keep that harbor closed to blockade running. What I meant about Cushing was that it was a pity [that] so much luck and dash had not brought fruits equal to the risk. You notice the Department never finds fault with these exploits. I believe they ought to be encouraged. To be sure, the people will say, when he is captured, "D— fool." The Department will not. I have been reading this new English naval history, and I find their wars abounded in rash coast attacks and cutting-out expeditions of all kinds; they were encouraged and formed a bright page of naval history. You may be very sure that the Department will not find any fault with any dashing expeditions that give reasonable hope of a result injurious to the enemy, even though they fail occasionally.

See how much they make out of John Taylor Woods' exploits—a solemn vote of thanks and everybody cheerful over the capture of three tugs. I am sure I do not blame them for being happy, for I have groaned over the loss constantly, because it was disgraceful to us in each case. Going into the river to destroy a blockade runner about to sail is a most happy idea, and most serious to the enemy, because cotton and despatches would be burned. The first officer that destroys one in this way I think I can promise shall go up several numbers on the list, according to the new law, and if it is Cushing we can add his former exploits and give him thirty numbers up. I think we should all gain credit for such an affair.

G. V. Fox.

REAR-ADMIRAL S. P. LEE,
Comdg. North Atlantic Blockading Squadron, Hampton Roads.

UNOFFICIAL LETTER FROM LIEUTENANT CUSHING, U. S. NAVY, TO ACTING REAR-ADMIRAL LEE, U. S. NAVY, PROPOSING TO ENGAGE THE ENEMY'S VESSELS, AND GIVING RESULTS OF OFF-SHORE CRUISING BY THE U. S. S. "MONTICELLO."

U. S. S. "MONTICELLO," BEAUFORT, N. C., May 9, 1864.

SIR: I write unofficially to you to say that, having just learned the particulars of the mortifying affair [this refers to the raid of the Confederate ram *Raleigh* against the blockaders May 6 and 7] off Wilmington, I deem it my duty to leave for the point of danger at once. I feel very badly over the affair, sir, and would have given my life freely to have had the power of showing my high regard for you and the honor of the service by engaging the enemy's vessels. If they are there when I arrive, I shall use the *Monticello* as a ram, and will go over her or to the bottom. If they are inside, I shall send in a written petition to carry the ram by boarding in the harbor. I enclose a copy of application and plan of operations. I trust that the success of this insulting bravado of the enemy will not lead you to distrust us all; I am confident that Captain Braine and myself can sink the ironclad.

My offshore cruising thus far has resulted in one chase, in company with the *Connecticut*, on the 12th of April. Just before black smoke was sighted my main valve stem got bent and it was eighty minutes after we saw it before my cut-off could be detached, giving the Englishman a chance to get to windward of me. I then chased for over 100 miles, but, with full stroke, could only keep up enough steam to go 11 knots. The vessel chased escaped from the *Connecticut*.

On the 22d of April I picked up the English schooner *James Douglass* outside the Gulf Stream, dismasted, and with no one on board. She had 6 feet of water in the hold, and a cargo of cocoanuts and bananas, which I hove overboard. Finding that she was a fine schooner of about 150 tons, and that she was sound and without a leak, I towed her in and will forward her, making a claim for at least 80 per cent salvage.

I think that the blockade runners have given up the direct route and go more to the southward.

There is no doubt but that my vessel can overtake the majority of those vessels, and I trust that you will not cancel my permission to cruise outside after this ram business is settled.

I am, sir, very respectfully,

W. B. CUSHING,

ADMIRAL S. P. LEE,
Hampton Roads, Virginia.

REPORT OF LIEUTENANT CUSHING, U. S. NAVY, SUBMITTING A PLAN FOR THE CAPTURE OF THE C. S. S. "RALEIGH."

WASHINGTON, D. C., May 21, 1864.

SIR: Deeming it possible to capture the rebel ironclad *Raleigh* at Wilmington, N. C., I submit the following plan, respectfully asking that it may receive your favorable consideration:

Selecting a time when the ram is anchored at Smithville, I can, as I have often done, take boats by the forts and up to the anchorage, and, covered by the darkness, approach to within a short distance of the enemy. The *Raleigh's* low, flat decks are very favorable to boarders, while there are but two small hatches communicating with officers' quarters and berth deck. The lookouts can easily be swept away and these hatches guarded, while the main force, rushing through ports and hatch, will secure the unprotected gun deck, which will give us the engine room and magazine hatch.

Objections have been made that after gaining the deck we could no more get at the lower portion of the vessel and the crew than they could get at us. To settle this point, I propose to take in the boats a dozen long-fused shell and a piece of slow match. One shell down each hatch would be likely to bring all hands to terms.

Having captured the ironclad we might bring her out or destroy her, as circumstances dictated.

With my knowledge of the harbor and of the ironclad, I am confident that I would succeed.

I have the honor, sir, to be, very respectfully, your obedient servant,

W. B. CUSHING,
Lieutenant, U. S. Navy, Commanding Monticello.

HON. GIDEON WELLES,
Secretary of the Navy.

LETTER FROM THE SECRETARY OF THE NAVY TO ACTING REAR-ADMIRAL LEE, U. S. NAVY, EXPRESSING APPROVAL OF THE ATTEMPTED DESTRUCTION OF THE C S. RAM "ALBEMARLE," AND APPROVING CUSHING'S PROPOSAL OF MAY 21.

NAVY DEPARTMENT, June 6, 1864.

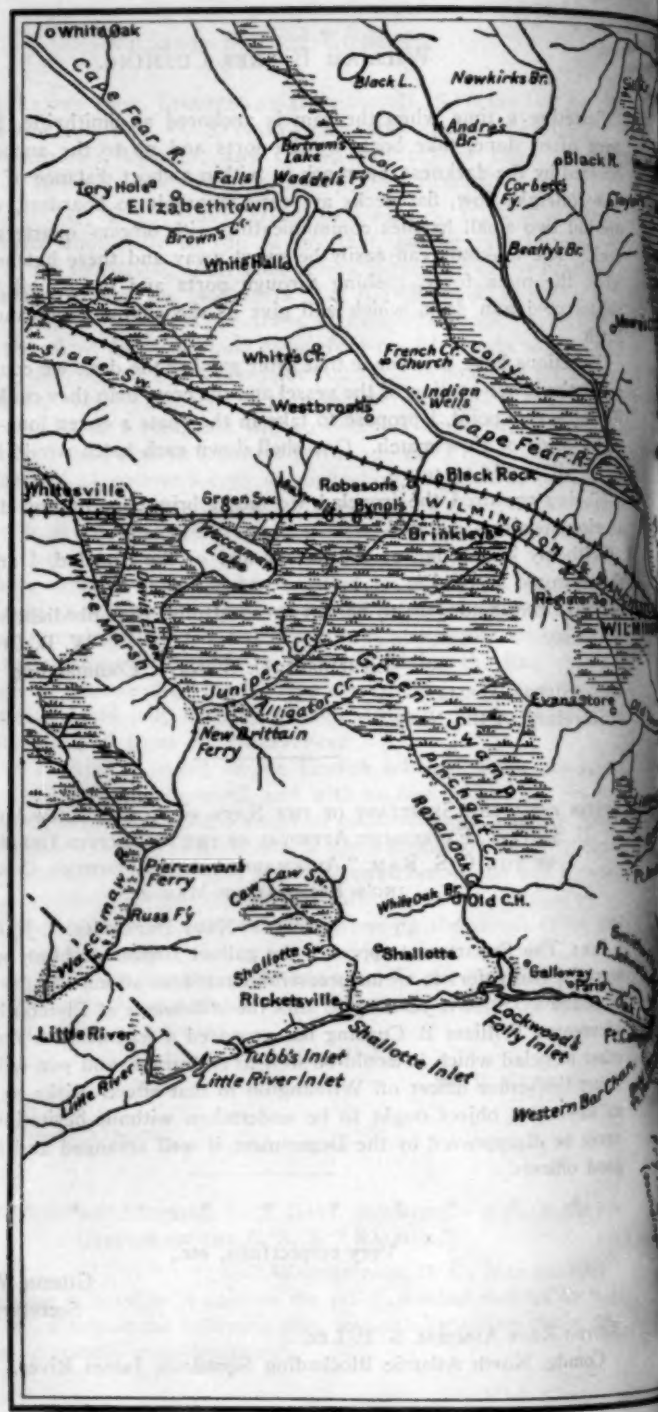
SIR: The Department approves the gallant attempt to blow up the *Albemarle*. [This refers to an unsuccessful, hazardous attempt by five volunteers from the U. S. S. *Wyalusing* to sink the *Albemarle* at Plymouth, May 26.] Lieutenant William B. Cushing has proposed a scheme with regard to another ironclad which it would be well to encourage, and you will please instruct the senior officer off Wilmington to that effect. Risks to accomplish an important object ought to be undertaken without hesitation, and will never be disapproved by the Department if well arranged and intrusted to good officers.

* * * * * * * * * * *

Very respectfully, etc.,

GIDEON WELLES,
Secretary of Navy.

ACTING REAR-ADMIRAL S. P. LEE,
Comdg. North Atlantic Blockading Squadron, James River.


White Oak
Cape Fear R.
Black L.
Newkirks Br.
Andrs Br.
Bertram's Lake
Falls
Waddell's Fy
Colly
Black R.
Corbett's Fy.
Tory Hole
Elizabethtown
Brown's Cr.
Beatty's Br.
White Hall
Slades Sw.
White's Cr.
French Cr. Church
Indian Wells
Westbrooks
Cape Fear R.
Whitesville
Green Sw.
Robesons
Black Rock
Symths
WILMINGTON
Brinkleys
Waccamaw Lake
White Marsh
Juniper Cr.
Alligator Cr.
Green Swamp
Evans Store
New Brittain Ferry
Pinchgut Cr.
Royal Oak Cr.
Piercewans Ferry
Caw Caw Sw.
White Oak Br.
Old C.H.
Russ Fy
Waccamaw R.
Shallotte Sw.
Shallotte
Galloway
Paris
Ricketsville
Lockwood's Folly Inlet
Little River
Tubb's Inlet
Shallotte Inlet
Little River Inlet
Little River
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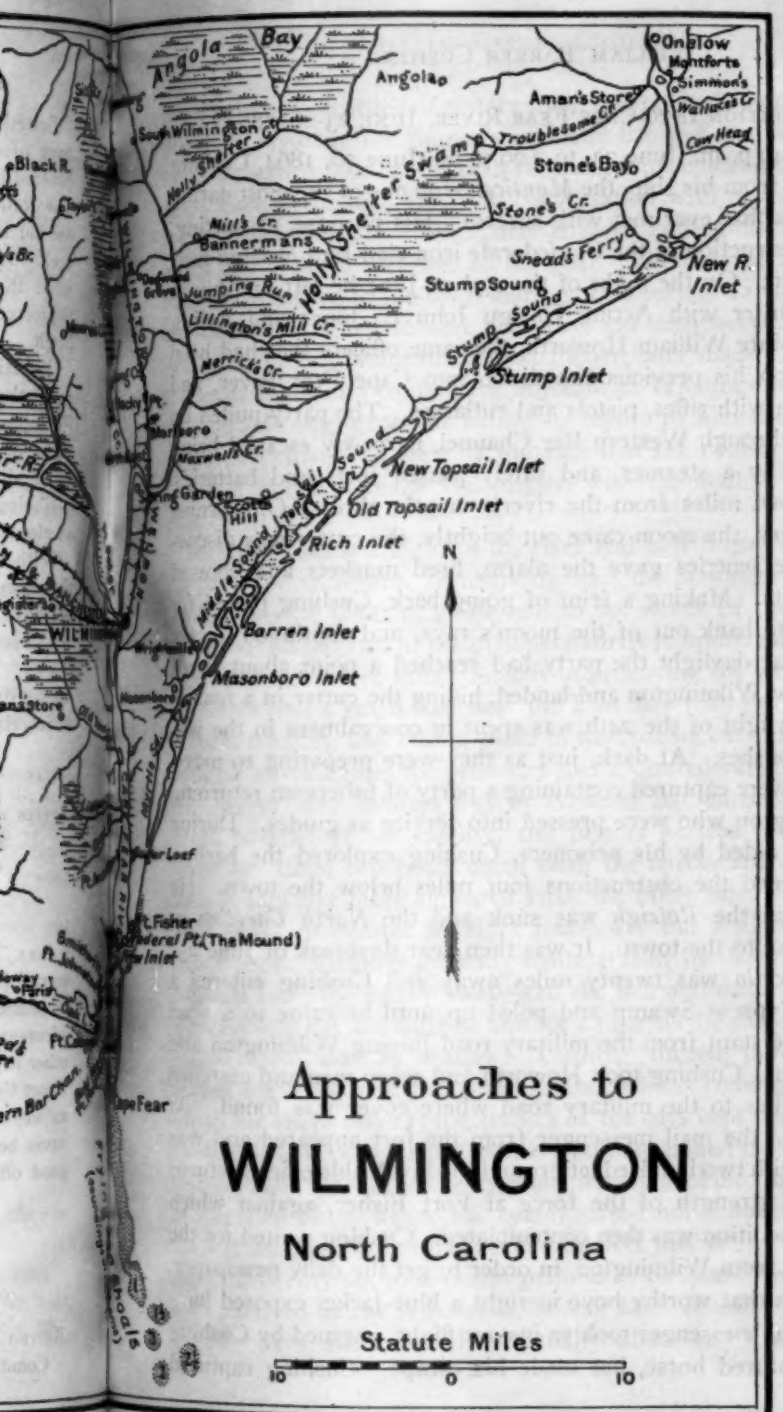
Angola Bay
Angola
Onslow
Montforts
Simmon's
Aman's Store
Wallaces Cr
Cow Head
Troublesome Cr
Stone's Bayo
Stone's Cr
Swamp
Holly Shelter
South Wilmington
Holly Shelter Cr
Mill's Cr
Bannermans
Sneads Ferry
New R. Inlet
Stump Sound
Jumping Run
Lillington's Mill Cr
Merrick's Cr
Stump Inlet
Starboro
Maxwells Cr
New Topsail Inlet
Old Topsail Inlet
Rich Inlet
Middle Sound
Barren Inlet
Masonboro Inlet
WILMINGTON
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EXPEDITION INTO CAPE FEAR RIVER, JUNE 23-26, 1864.

From 8.40 p. m., June 23, to 2.20 p. m., June 26, 1864, Cushing was absent from his ship, the *Monticello,* on one of the most daring expeditions that ever met with success. His purpose, at starting, was the destruction of the Confederate iron-clad ram *Raleigh* near Wilmington. On the night of the 23d of June he left his ship in the first cutter with Acting Ensign John E. Jones and Acting Master's Mate William Howorth, the same officers that had been with him on his previous expedition into Cape Fear River, and fifteen men with rifles, pistols and cutlasses. The party pulled up the river, through Western Bar Channel, narrowly escaped being run down by a steamer, and safely passed forts and batteries. When fifteen miles from the river's mouth, abreast Old Brunswick Battery, the moon came out brightly, the cutter was discovered, shore sentries gave the alarm, fired muskets and showed signal lights. Making a feint of going back, Cushing pulled for the opposite bank out of the moon's rays, and continued up the river. Near daylight the party had reached a point about seven miles below Wilmington and landed, hiding the cutter in a marsh. All the daylight of the 24th was spent in concealment in the willows and bushes. At dark, just as they were preparing to move, two boats were captured containing a party of fishermen returning to Wilmington who were pressed into service as guides. During the night, aided by his prisoners, Cushing explored the harbor, and examined the obstructions four miles below the town. He learned that the *Raleigh* was sunk and the *North Carolina* at anchor close to the town. It was then near daybreak of June 25; the *Monticello* was twenty miles away and Cushing entered a creek in Cypress Swamp and poled up until he came to a road two miles distant from the military road joining Wilmington and Fort Fisher. Cushing took Howorth and seven men and marched the two miles to the military road where cover was found. At 11.30 a. m., the mail messenger from the fort appeared and was captured with two hundred letters and the invaluable official returns giving the strength of the force at Fort Fisher, against which fort an expedition was then contemplated. Cushing waited for the messenger from Wilmington, in order to get the daily newspaper, and just as that worthy hove in sight a blue-jacket exposed himself, and the messenger took to instant flight, pursued by Cushing on the captured horse, but made his escape. Cushing captured

more prisoners, learned of a store some two miles distant, and sent Howorth, wearing the courier's coat and hat and mounted on his horse to secure food. Howorth returned with chickens, milk and eggs, having engaged freely in conversation with many persons. After a delicious dinner the party enjoyed cutting the telegraph wires and at dark returned to the boat. The courier from Wilmington returned to the town and reported seeing Yankee sailors, but he was laughed at and his story was disbelieved. Colonel William Lamb, Commanding Fort Fisher, later made earnest but unsuccessful efforts to have the adjutant at Wilmington punished for culpable negligence in failing to report to him the courier's story, particularly in view of the fact that the courier from the fort had failed to reach Wilmington with the mail at the usual time.

The third and last night in the river had now begun and Cushing prepared to return. Embarking with the prisoners he forced one of them, a pilot, to guide him to the wreck of the *Raleigh*, having set all but two of the prisoners adrift in midstream in small boats without oars or sails. Shortly after leaving the wreck Cushing discovered a small boat near the East Bar with six men, four of them soldiers, and taking them in his boat he cut theirs adrift. Cushing learned from the prisoners that a Confederate guard boat with seventy-five soldiers was in Western Bar entrance and resolved to attempt her capture, and just as he was preparing to attack her three row-boats came from the northward and at the same instant five more appeared from the other side. The cutter was nearly surrounded by eight row-boats and a schooner filled with troops. Cushing instantly made a feint by dashing toward Western Bar; the enemy swallowed the bait and dashed ahead to intercept him but lost sight of him for a time, as the side of his boat toward them was in shadow. Cushing turned suddenly and headed for New Inlet full speed. His coolness communicated itself to his brave sailors; the strokes of the oars kept perfect time; his deep-laden boat by extraordinary pulling gained the passage of the island and before the enemy could prevent shot into the breakers on Caroline Shoal where the enemy dared not follow. Cushing reached the *Cherokee* of the blockading fleet just as day was breaking with twenty-six men (eight prisoners) on board, and at 12.20 p. m., arrived at the *Monticello*, having been absent three nights and two days, and suffered no casualty whatever. Cushing gave

great credit to his men and officers who received the commendation of the squadron commander and the Navy Department. The Confederates were astounded. Colonel Lamb was furious. Guards and guard-boats were trebled. General Whiting, the Confederate commander of the defenses of Wilmington reported that the enterprising commander of the *Monticello* had passed his forts, captured and carried off his soldiers, eluded picket boats sent to capture him, and aroused the wildest apprehensions. The Confederates were searching for Cushing for days after he had returned to the *Monticello*. Colonel Lamb tells that his soldiers would play jokes at night, pretending that they were Cushing and party, thereby causing great alarm in the fort.

REPORT OF LIEUTENANT CUSHING, U. S. NAVY.

U. S. S. "MONTICELLO," off WILMINGTON, N. C., July 2, 1864.

SIR: In consequence of permission received from you to attempt the destruction of the ironclad ram *Raleigh*, I proceeded to the blockade at that point with the intention of doing so. Judging it prudent to make a thorough reconnoissance, first, to determine her position, I left this ship on the night of the 23d, in the first cutter, with two officers (Acting Ensign J. E. Jones and Acting Master's Mate William Howorth) and 15 men, and started in for the Western Bar. I succeeded in passing the forts, and also the town and batteries of Smithville, and pulled swiftly up the river.

As we neared the Zeek's Island batteries, we narrowly escaped being run down by a steamer, and soon after came near detection from the guard boat, but evading them all we continued our course.

As we came abreast of the Old Brunswick batteries, some 15 miles from the starting point, the moon came out brightly and discovered us to the sentinels on the banks, who hailed at once, and soon commenced firing muskets and raising an alarm by noises and signal lights. We pulled at once for the other shore obliquely, so as to give them to understand that we were going down, but as soon as I found that we were out of the moon's rays we continued our course straight up, thereby baffling the enemy and gaining safety. When within 7 miles from Wilmington, a good place was selected on the shore, the boat hauled up and into a marsh, and the men stowed along the bank.

It was now nearly day, and I had determined to watch the river, and, if possible, to capture some one from whom information could be gained.

Steamers soon began to ply up and down, the flagship of Commodore Lynch, the *Yadkin*, passing within 200 yards. She is a wooden propeller steamer of about 300 tons; no masts, one smokestack, clear deck, English build, with awnings spread fore and aft, and mounting only two guns. Did not seem to have many men. Nine steamers passed in all, three of them being fine, large blockade runners.

Just after dark, as we were preparing to move, two boats rounded the point, and the men, thinking it an attack, behaved in the coolest manner.

Both boats were captured, but proved to contain a fishing party returning to Wilmington.

From them I obtained all the information that I desired, and made them act as my guides in my further exploration of the river.

Three miles below the city I found a row of obstructions, consisting of iron pointed spiles, driven in at an angle, and only to be passed by going into the channel left open, about 200 yards from a heavy battery that is on the left bank. A short distance nearer the city is a ten-gun navy battery and another line of obstructions, consisting of diamond-shaped crates, filled and supported in position by two rows of spiles, the channel in this instance being within 50 yards of the guns. A third row of obstructions and another battery complete the upper defenses of the city. The river is also obstructed by spiles at Old Brunswick, and there is a very heavy earthwork there.

Discovering a creek in the Cypress Swamp, we pulled or rather poled up it for some time, and at length came to a road, which, upon being explored, proved to connect with the main road from Fort Fisher and the sounds to Wilmington. Dividing my party, I left half to hold the cross-road and creek, while I marched the remainder some 2 miles to the main road and stowed away.

About 11.30 a. m. a mounted soldier appeared with a mail bag and seemed much astonished when he was invited to dismount, but as I assured him that I would be responsible for any delay that might take place he kindly consented to shorten his journey. About two hundred letters were captured, and I gained such information as I desired of the fortification and enemy's force. As an expedition was contemplated against Fisher by our army about this time, the information was of much value.

There are 1300 men in the fort, and the unprotected rear that our troops were to storm is commanded by four light batteries. I enclose rebel requisitions and report of provisions on hand.

I now waited for the courier from the other direction, in order that we might get the papers that were issued at 1 p. m. in Wilmington, but just as he hove in sight a blue jacket exposed himself and the fellow took to instant flight. My pursuit on the captured horse was rendered useless from lack of speed, and the fellow escaped after a race of some 2 miles. In the meantime we captured more prisoners and discovered that a store was located about 2 miles distant, and being sadly in need of some grub, Mr. Howorth, dressed in the courier's coat and hat, and mounted upon his horse, proceeded to market.

He returned with milk, chickens, and eggs, having passed everyone, in and out of service, without suspicion, though conversing with many.

At 6 p. m., after destroying a portion of the telegraph wire, we rejoined the party at the creek and proceeded down, reaching the river at dark.

In trying to land our prisoners upon an island a steamer passed so close that we had to jump overboard and hold our heads below the boat to prevent being seen. As we had more prisoners than we could look out for, I determined to put a portion of them in small boats and set them adrift without oars or sails, so that they could not get ashore in time to injure us. This was done, and we proceeded down the river, keeping a bright

lookout for vessels in order to burn them, if possible. None was found, but I forced the pilot to take me to where the ram *Raleigh* was said to be wrecked. She is, indeed, destroyed, and nothing now remains of her above water.

The ironclad *North Carolina*, Captain Muse, commanding, is in commission, and at anchor off the city. She is but little relied upon, and would not stand long against a monitor.

Both torpedo boats were destroyed in the great cotton fire some time since. One was very near completion.

As I neared the forts at the East Bar, a boat was detected making its way rapidly to the shore, and captured after a short chase. It contained six persons, four of whom were soldiers. Taking them all into my boat, I cut theirs adrift, but soon found that 26 persons were more than a load. By questions I discovered that at least one guard boat was afloat, containing 75 musketeers, and situated in the narrow passage between Federal Point and Zeek's Island. As I had to pass them I determined to engage the enemy at once, and capture the boat if feasible. The moon was now bright, and as we came near the entrance I saw what we supposed to be one large boat just off the battery, but as we prepared to sail into her, and while about 20 yards distant, three more boats suddenly shot out from that side, and five more from the other, completely blocking up the sole avenue of escape. I immediately put the helm down, but found a large sailboat filled with soldiers to windward and keeping us right in the glimmer of the moon's rays.

In this trying position both officers and men acted with true coolness and bravery. Not the stroke of an oar was out of time; there was no thought of surrender, but we determined to outwit the enemy or fight it out. Suddenly turning the boat's head, we dashed off as if for the Western Bar, and by throwing the dark side of the boat toward them were soon lost to view.

The bait was eagerly seized, and their whole line dashed off at once to intercept us.

Then again turning, by the extraordinary pulling of my sailors, I gained the passage of the island, and before the enemy could prevent, put the boat into the breakers on Caroline Shoals.

The rebels dared not follow, and we were lost to view before the guns of the forts trained on the channel could be brought to bear upon our unexpected position. Deeply loaded as we were, the boat carried us through in fine style, and we reached the *Cherokee* just as day was breaking, and after an absence from the squadron of two days and three nights. I am now posted in regard to the city land and water defenses, and everything that it will interest the Department to know. I beg leave to call your attention, sir, to the fact that Acting Ensign J. E. Jones and Acting Master's Mate William Howorth are the same officers who accompanied me to Smithville some months since, and whom I select because of their uniform enterprise and bravery.

All the men did well, but my coxswain, David Warren, is deserving of a medal of honor for marked bravery in every critical moment. I would also mention Ordinary Seaman John Sullivan and Yeoman William Wright, the latter having volunteered upon every expedition of danger since this

ship has been in commission, in this instance procuring his discharge from the sick list in order to do service.

I am, sir, very respectfully, your obedient servant,

WM. B. CUSHING,
Lieutenant, Commanding.

ACTING REAR-ADMIRAL S. P. LEE,
Commanding North Atlantic Blockading Squadron.

(Endorsement.)

July 6, 1864.

I submit this important reconnoissance to the Department with my hearty approval of the skill and gallantry displayed by Lieutenant W. B. Cushing and the good conduct of the officers and men serving under him.

S. P. LEE,
Actg. Rear-Admiral, Comdg. North Atlantic Blockading Squadron.

ABSTRACT LOG OF THE U. S. S. "MONTICELLO," LIEUT. CUSHING, U. S. NAVY, COMMANDING.

June 20, 1864.—Ship lying to anchor off the shoals. At 8 p. m. got underway and stood in to Fort Caswell. At 9.35 p. m. Captain Cushing, accompanied by Acting Ensign Jones and Acting Master's Mate William Howorth, and 15 men with cutlasses, rifles, and pistols left the ship on an expedition. At 10 the batteries opened fire upon the ship. Stood out and anchored with kedge. At 12, first cutter returned to the ship.

June 23.—At 8.40 p. m. Captain Cushing and Acting Ensign J. E. Jones and Acting Master's Mate W. L. Howorth, with 15 men, went in on a boat expedition, with two day's rations—beef, pork, bread, etc.—with 11 revolvers, 7 pistols, 6 Sharps rifles, and ammunition.

June 26.—At 12.30 p. m. the steamer *Cherokee* arrived from the north side, having in tow our first cutter. At 2.20 p. m. the first cutter returned to the ship, they having succeeded in getting within 4½ miles of Wilmington. Had possession of the main road Saturday. They captured the mail-carrier and mail. Cut the telegraph wire. The prisoners brought to the ship.

LETTER OF COMMENDATION FROM THE SECRETARY OF THE NAVY TO LIEUTENANT CUSHING, U. S. NAVY.

NAVY DEPARTMENT, July 14, 1864.

SIR: The Department has received, through Acting Rear-Admiral Lee, your report of the 2d instant of your reconnoissance of the harbor of Wilmington, N. C.

The boldness exhibited by you on this reconnoissance and the success attending it are most gratifying to the Department. While expressing its thanks to you, the Department does not forget that you are much indebted for your success in this, as on your recent previous reconnoissance, to the brave officers and men who accompanied you and were under your command. Please make known to Acting Ensign J. E. Jones and Acting

Master's Mate W. L. Howorth, whom you commend for enterprise and bravery, the Department's appreciation of their conduct.

To your coxswain, David Warren; William Wright, yoeman, and John Sullivan, seaman, medals of honor will be awarded.

Very respectfully, etc.,

GIDEON WELLES,
Secretary of the Navy.

LIEUTENANT WM. B. CUSHING,
Commanding U. S. S. *Monticello*, off Wilmington.

Admiral Porter wrote:

Cushing's hazardous undertakings were sometimes criticized as useless, but there was more method in them than appeared on the surface, and important information was sometimes obtained, to say nothing of the brilliant example of courage and enterprise which they afforded to others.

Cushing did not always have plain sailing. The master of the British brig *Hound*, examined by him on July 1, 1864, filed complaint against the young commanding officer and the Navy Department administered a stern rebuke, yet, reading between the lines one can see that Cushing was a boy after Gideon Welles' own heart.

REPORT OF LIEUTENANT CUSHING, U. S. NAVY, REGARDING THE BOARDING OF THE BRITISH BRIG "HOUND," JULY 1, 1864.

NAVY DEPARTMENT, WASHINGTON, D. C., September 2, 1864.

SIR: The communication of the Department in reference to the British brig *Hound*, with the enclosures,* has been received, and in reply I would state that at the time the *Monticello* was on her station off Wilmington, N. C., a small brig was reported in sight, and as usual directions were given to board her and overhaul her papers. I did not go on deck, but my executive officer, Acting Ensign Charles A. Pettit, carried the ship within hail and demanded name, destination, cargo, etc. By this time the steamer had forged ahead so as to be out of convenient hail, and two or three musket shots were fired well across the bow to bring her to. All the great guns were loaded with shell, and it was not deemed necessary to fire one. There was nothing dangerous or improper about the musket firing, but merely a notification that we wished to board. The captain of the *Hound*, however, hailed my ship in the most insulting manner, using oaths to emphasize his language, and my boarding officer, Acting Ensign Joseph Hadfield, reported on his return that the language and manner of the Englishman had been in the last degree improper both on deck in the presence of his men and below in the cabin. The brig was not too large for a blockade runner and was in my cruising limits; and I thought proper to overhaul

* Not necessary to publish—complaint of Lord Lyons, British Minister, to State Department.

her again and examine the papers myself, and in order to do so at my leisure I sent a boat to bring the captain and his papers. I have directed my officers to bring captain and papers on board in all cases where a spirit of malice is to be perceived, as I deem it a trick by which a captain might cause the boarding officer to overlook any informalities in the ship's papers.

The captain of the brig came aboard, and I took his papers, telling him I would look them over at my leisure, and he could remain or go aboard his ship, as he pleased. He informed me that he would remain, with my permission. I enquired what his conduct had been, and he answered by lame excuses and final retraction. I told him that he should see the propriety of apologizing to the boarding officer, and he expressed his willingness to do so. I then examined his papers, and finding them correct, told the captain to proceed.

It would have made no difference in my action had the ship been American, or of other nationality, for a national ship must be treated with respect.

I have the honor, sir, to be, very respectfully, your obedient servant,

W. B. CUSHING,
Lieutenant, Commanding U. S. S. *Monticello.*

HON. GIDEON WELLES,
Secretary of the Navy.

LETTER FROM THE SECRETARY OF THE NAVY TO LIEUTENANT CUSHING, U. S. NAVY, DISAPPROVING HIS COURSE IN THE CHASE OF THE BRITISH BRIG "HOUND."

NAVY DEPARTMENT, September 10, 1864.

SIR: I have received your report of the 2d instant in explanation of your proceedings on the 1st of July last at sea, in the case of the British brig *Hound*, against which complaints have been justly made.

Your own statement and that of the master of the brig concur in the following particulars:

That, in the exercise of the belligerent right of search, you fired musket shots across the bow of the *Hound* to bring her to; that she was boarded and her papers examined and found correct by the boarding officer, and the vessel ascertained to be on a legitimate voyage; that the vessel was permitted to proceed on her course, was subsequently overhauled again and boarded, but the captain, with his papers, was brought on board the *Monticello*, unlawfully and unnecessarily detained, and then permitted to resume his voyage.

The Department fails to find in your explanation any excuse for your disregard of international law and courtesy, but regrets to perceive in your conduct a disregard of both, and a flagrant violation of its oft-repeated instructions.

The customary notice of your desire to speak the *Hound* by showing your colors and firing a blank cartridge was not, in the first instance, observed. The use of musketry was a departure from the recognized practice. After the right of search had been exercised, no ground for detention or seizure discovered, and the vessel allowed to proceed, she was again brought to and unwarrantable and unjustifiable measures adopted.

What was your object in again overhauling the brig? You state that your boarding officer reported on his return from the first examination that the language and manner of the master of the brig had been in the last degree improper, both on deck in the presence of his men and below in the cabin, and that you thought proper to overhaul her again and examine the papers yourself, and in order to do so at your leisure, you brought the captain and his papers on board the *Monticello,* which is your custom where a spirit of malice is perceived, which is a trick that might cause a boarding officer to overlook any informalities in the ship' papers.

If on hearing the report of the boarding officer there had been anything in it to induce you to believe that the vessel was not all right, it would not have been improper in you to overhaul the vessel for the purpose of making a personal examination of the papers or the vessel itself. But there was impropriety in taking the master out of his ship, carrying him on board your own, and there detaining him some hours, with a view to examining the papers at your leisure. Something more than the verification of the vessel's papers is apparent in your procedure; a disposition was exhibited, if the object was not actually accomplished, to punish the master of the brig for an offense against courtesy, and a manifestation of authority, assumed rather than rightful, over him and the vessel in his charge. In adopting this course of correcting a discourtesy on the part of the master of the brig, you inflicted injury on the owners of the vessel in unnecessarily detaining her, and abused the belligerent right of search.

Were this the first time the Department has had to remind you of the necessity of rigidly observing the customary rules on the high seas, it might have been induced to express in milder terms its disapprobation of your proceedings in the case of the *Hound.* I enclose herewith a copy of the circular instructions of the Department to our cruisers, issued August 18, 1862, and trust that you will give them attention, considering well their injunction to "exercise great forbearance with great firmness, and manifest to the world that it is the intention of our Government, while asserting and maintaining our own rights, to respect and scrupulously regard the rights of others."

The Department is not upholding the master of the brig in his discourteous and offensive manner to the boarding officer of the *Monticello,* but cannot allow his conduct to shield you against an earnest expression of its disapprobation.

In conclusion, I must enjoin upon you to be more cautious in future. Such proceedings repeated cannot fail to bring upon you the serious displeasure of your Government and result to your regret and injury. While the Department is always ready to accord to officers of the service, as it has in several instances in your own case, due credit for valor and efficiency in the discharge of duty, it is not the less so to disapprove and punish when disapprobation and punishment are deserved.

Very respectfully, etc.,

GIDEON WELLES,
Secretary of the Navy.

LIEUTENANT WM. B. CUSHING, U. S. Navy, New York.

(Confidential.)

FLAGSHIP NORTH ATLANTIC BLOCKADING SQUADRON, HAMPTON ROADS,
Virginia, July 9, 1864.

SIR: Lieutenant Cushing arrived here on the 5th instant, bringing his report of his reconnoissance near Wilmington. I suggested his making an attempt to destroy the rebel ram *Albemarle* at Plymouth. He at first proposed an attack on the ram with our gunboats at Plymouth, or a boat expedition, led by himself, with 80 men.

I concur in Captain Smith's opinion that it would be inexpedient to fight the ram with our long double-enders in that narrow river. I proposed to Lieutenant Cushing a torpedo attack, either by means of the india-rubber boat heretofore applied for, which could be transported across the swamp opposite Plymouth, or a light-draft, rifle-proof, swift steam barge, fitted with a torpedo.

In the meantime delay ensued from the *Monticello* getting ashore in the Elizabeth River. The enclosed letter from Lieutenant Cushing contains his mature views on the subject. The *Monticello* will return to the blockade as soon as Lieutenant Kempff arrives, who is hourly expected, and Lieutenant Cushing, who desires to superintend the fitting of the boats he may have, is instructed to report to the Department and deliver this communication. I have enjoined secrecy and discretion upon him. He is entirely willing to make an attempt to destroy the ram, and I have great confidence in his gallantry.

I have the honor to be, sir, very respectfully, yours,

S. P. LEE,

Actg. Rear-Admiral, Comdg. North Atlantic Blockading Squadron.

HON. GIDEON WELLES,
Secretary of the Navy, Washington, D. C.

(Subenclosure.)

(Confidential.)

U. S. S. "MONTICELLO," HAMPTON ROADS, Virginia, July 9, 1864.

SIR: Deeming the capture or destruction of the rebel ram *Albemarle* feasible, I beg leave to state that I am acquainted with the waters held by her, and am willing to undertake the task.

If furnished with three low-pressure tugs, one or more fitted with torpedoes, and all armed with light howitzers, it might be effected, or, if rubber boats were on hand to transport across the swamp to a point immediately abreast of Plymouth. If detailed for this work, I would like to superintend the outfit of the boats, and would be glad to see Lieutenant Kempff, of the *Connecticut*, in charge of the *Monticello* during my absence.

I am, sir, very respectfully, your obedient servant,

W. B. CUSHING,
Lieutenant, Commanding.

ACTING REAR-ADMIRAL S. P. LEE,
Comdg. North Atlantic Blockading Squadron, Hampton Roads.

Cushing's plan to fit out torpedo boats to destroy the *Albemarle* was heartily approved by the Navy Department, and the work of preparation was done at the New York Navy Yard. Assistant Engineer George W. Melville, later a rear-admiral, gave Cushing great assistance, doing much of the blacksmith work with his own hands and with his usual energy and skill. Commander Charles Stewart Boggs also aided Cushing in this preparation of his torpedo boats.

NAVY DEPARTMENT, July 28, 1864.

SIR: Proceed to New York and report to Rear-Admiral Gregory, who will assist you in the purchase of a suitable tug and india-rubber boat.

Very respectfully,

GIDEON WELLES,
Secretary of the Navy.

LIEUTENANT W. B. CUSHING, U. S. NAVY.
Commanding U. S. S. *Monticello*, Present.

(Telegram.)

NAVY DEPARTMENT, August 7, 1864.

Fit out as early as practicable two of the picket boats for Lieutenant W. B. Cushing.

GIDEON WELLES,
Secretary of the Navy.

REAR-ADMIRAL F. H. GREGORY, U. S. Navy, New York.

U. S. HOTEL, NEW YORK, September 9, 1864.

SIR: Can I send the picket boats through the canal to Chesapeake Bay in charge of their officers, and go myself by the usual route and meet them there? The torpedo is all that detains them now, and that will soon be completed.

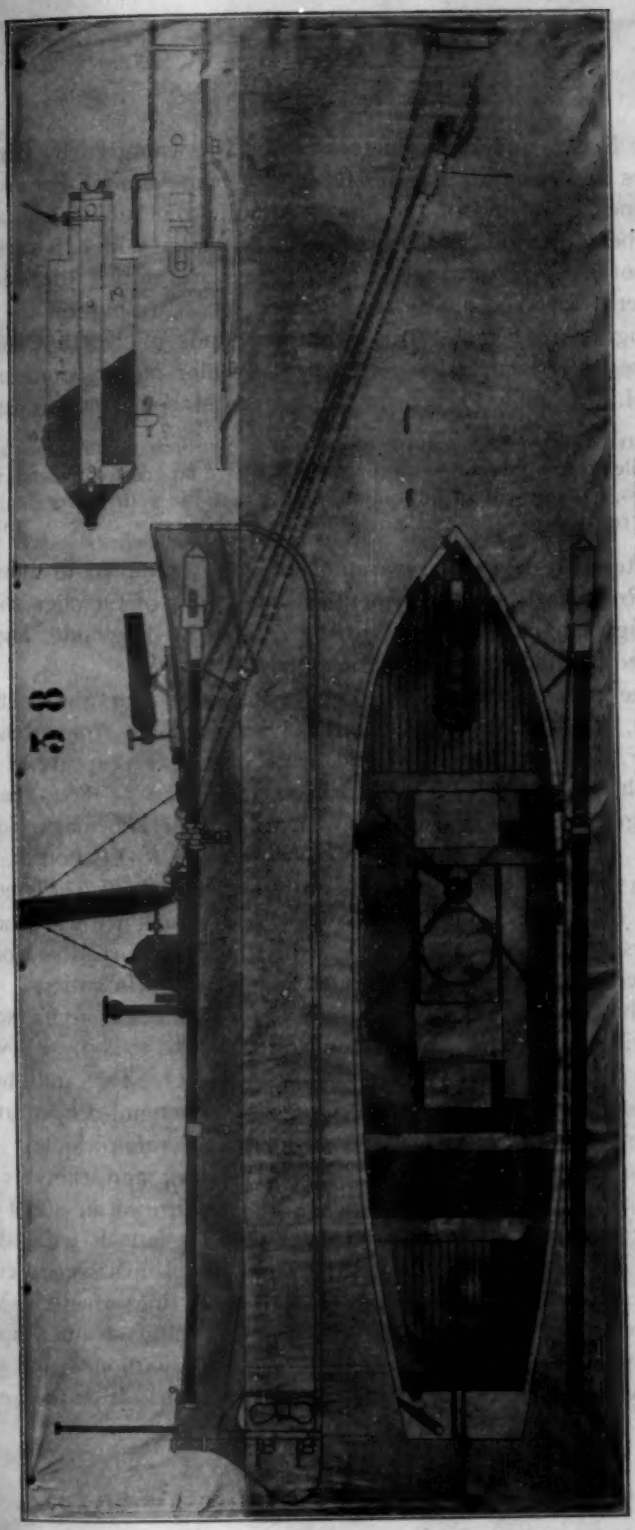
Very respectfully,

W. B. CUSHING,
Lieutenant, U. S. Navy.

HON. G. V. FOX,
Assistant Secretary of the Navy, Washington, D. C.

EXPEDITION FOR THE DESTRUCTION OF THE C. S. RAM "ALBEMARLE," AT PLYMOUTH, N. C., OCTOBER 27-28, 1864, UNDER THE COMMAND OF LIEUTENANT CUSHING, U. S. NAVY.

The two picket-boats, each about thirty feet in length, with torpedoes and spars made the trip from New York by inland route. Picket Boat No. 1 and Cushing arrived safely at Hampton Roads, October, 10, 1864, after a trying and dangerous trip. Picket



ORIGINAL PLANS OF CUSHING'S TORPEDO LAUNCH, BOOM AND TORPEDO.

Boat No. 2, under a volunteer officer was captured by Confederates in Wicomico Bay, October 8. Rear-Admiral Porter who assumed command of the North Atlantic Blockading Squadron, October 12, 1864, sent Cushing, weak and worn with exposure and loss of sleep on a three day's fruitless search for the missing Picket Boat No. 2. Finally Porter sent Cushing on his way through the Dismal Swamp to the sounds of North Carolina, where he arrived and reported to the senior officer, Commander W. H. Macomb. Porter's instructions to Macomb read in part:

> I have directed Lieutenant Cushing to go down in a steam launch and if possible destroy this ram with torpedoes. I have no great confidence in his success, but you will afford him all the assistance in your power, and keep boats ready to pick him up in case of failure.

After two days of preparation Cushing attempted to move up the Roanoke River to Plymouth on the night of October 26, but got aground and returned to the *Otsego* in the sound, and arranged to attack the ram on the night of the 27th.

The ram *Albemarle* had engaged the wooden gun-boats on April, 19, 1864, and driven the Union vessels from Roanoke River, sunk the *Southfield* and made certain the capture of Plymouth, which surrendered April 20. On May 5, 1864, she had engaged the squadron in the western part of Albemarle Sound, badly damaged the *Sassacus*, and withdrawn to Plymouth. She lay in October, 1864, below the custom house wharf in Plymouth, stern upstream, moored to the bank and wharf, with a boom of cypress logs around her to prevent her injury by torpedoes, for the Confederates were well informed of Cushing's intentions. Plymouth is on the right bank of the river eight miles from its mouth. The river in autumn stages is low and slow, 150 to 200 yards wide, lined on both banks with swamp land timber. One mile below Plymouth lay the wreck of the *Southfield*, commanded by a battery abreast her. On the wreck were four Confederate pickets.

The night of October 27, 1864, was dark and rainy in the sounds, with light airs and breezes, temperature of air about 66°, water 55°. At 11.28 p. m., Cushing in his launch with fifteen souls aboard left the *Shamrock*, towing that ship's second cutter with Acting Gunner William Peterkin, Acting Master's Mate Wilson D. Burlingame, and ten men. Cushing steamed up the river past the Southfield and battery abreast without being seen, cast off the cutter with orders to capture the pickets on the *South-*

MOUTHS OF ROANOKE RIVER
SHOWING SCENE OF NAVAL OPERATIONS
CONNECTED WITH THE CAPTURE OF PLYMOUTH, N.C.,
APRIL, 1864.
—Union Defences (approximate) from map by
Captain F.U.Farquhar, U.S.A.
.....Obstructions.
SOUNDINGS IN FEET
BATCH'E'LOR'S
BAY
Croatan River
Broad Cr.

field, and proceeded to attack the ram. When seen and hailed by the sentries, Cushing was not disturbed but maneuvered for a fair position under the enemy's continuous fire, discharged his 12-pounder howitzer at the enemy, sang out "Leave the ram! we are going to blow you up," rushed at the boom, passed over it, coolly detached his torpedo and exploded it under the port quarter of the ram, sinking her at her moorings. Cushing ordered his men to save themselves, removed his shoes and coat, and sprang into the river, swam to a point below the town, lay in a swamp a part of the next day, found a skiff in a creek, reached the sound and rowed toward the *Valley City*, whose log for October 28 reports his arrival as follows:

> At 10.15 p. m. heard some one hailing for a boat. Went to quarters, and slipped the cable, sent an armed boat away in charge of Acting Ensign Milton Webster, which brought on board Lieutenant William B. Cushing.

The log of the *Shamrock* records that her second cutter returned at 6.45 a. m., with four prisoners from the *Southfield*, reporting that the launch had attacked the ram, and the ram had kept up a heavy fire of musketry and artillery for about ten minutes, that the *Valley City* blew her whistle at 11.00 p. m., and at 11.30 p. m. came alongside with Cushing, who reported the ram blown up and launch sunk. All hands "cheered ship," the *Shamrock* fired a IX-inch gun and signaled the fleet.

The crew in the launch, seven officers and eight men, were mainly volunteers. Cushing and a fireman, Houghton, escaped. Acting Master's Mate Woodman and Fireman Higgins were drowned. Five officers and six men were taken prisoners.[4]

The immediate result of Cushing's exploit was the fall of Plymouth, but the total result can never be measured. It is immeasurable. For intrepid courage it is unequaled. As an example and inspiration it is immortal.

The thanks of Congress to Cushing for blowing up the *Albemarle* gave him a promotion of one grade which advanced him about fifty numbers in rank, and fifteen months in date. For the gallant deed of sinking the *Merrimac* in Santiago Channel, Lieu-

[4] The accounts of the marvelous heroism of Cushing in "Battles and Leaders;" "Blockade and Cruisers," by Soley; Harper's Magazine for July, 1874; Naval War Records, Vol. 10 *et al.*; "Three Wisconsin Cushings," by Theron Wilber Haight; and "Commander William Barker Cushing," by E. M. H. Edwards, are spirited, thrilling and felicitous.

tenant Hobson was promoted four grades, and about thirteen years in date. For burning the *Philadelphia* in Tripoli Harbor, Decatur was promoted two grades and about ten years in date.

Cushing's little launch was recaptured by Commander Macomb, repaired and used as an instruction boat for cadets at the U. S. Naval Academy for many years.

The *Albemarle* was raised and taken to Norfolk where the metal was stripped from her and her hull sold. She was built by Gilbert Elliott, a youth one year younger than Cushing. Her keel was laid in a cornfield at Edward's Ferry on Roanoke River, and she was completed just in time to give battle to the Union gun-boats, April 19, 1864. She was a twin screw ironclad ram, 158 feet long, 35 feet wide, 4-inch armor, 9 feet draft, and carried at each end a 6.4-inch Brooke rifle which fired from three hinged ports. The bow gun could fire ahead or on either side. The stern gun could fire astern or on either side. Owing to the bar at the mouth of Roanoke River she could not pass into Albemarle Sound except at time of high water in the river which occurred during the spring months.

(Telegram.)

FORTRESS MONROE, VA., November 1, 1864. (Received 1.25 p. m.)

I sent Lieutenant Cushing on the 17th of October, with picket launch No. 1, to blow up the ram *Albemarle*. He returned to-day and reports to me he blew up the *Albemarle* on the morning of the 28th. The destruction was complete. Picket launch No. 1 was destroyed by the enemy's shot and sunk; one man escaped with Lieutenant Cushing; the others captured. I promised Cushing promotion to another grade if he succeeded. Hope the Department will honor the promise if the report is corroborated. Commander Macomb writes me: "From circumstances which have since occurred, I am able to inform you that the ram is sunk."

DAVID D. PORTER,
Rear-Admiral.

HON. GIDEON WELLES,

REPORT OF LIEUTENANT CUSHING, U. S. NAVY, COMMANDING EXPEDITION.

ALBEMARLE SOUND, NORTH CAROLINA, October 30, 1864.

SIR: I have the honor to report that the rebel ironclad *Albemarle* is at the bottom of the Roanoke River. On the night of the 27th, having prepared my steam launch, I proceeded up toward Plymouth with 13 officers and men, partly volunteers from the squadron.

The distance from the mouth of the river to the ram was about 8 miles, the steam averaging in width some 200 yards, and lined with the enemy's pickets. A mile below the town was the wreck of the *Southfield*, sur-

rounded by some schooners, and it was understood that a gun was mounted there to command the bend. I, therefore, took one of the *Shamrock's* cutters in tow, with orders to cast off and board at that point if we were hailed. Our boat succeeded in passing the pickets, and even the *Southfield*, within 20 yards, without discovery, and we were not hailed until by the lookouts on the ram. The cutter was then cast off and ordered below, while we made for our enemy under a full head of steam.

The rebels sprung their rattle, rang the bell, and commenced firing, at the same time repeating their hail and seeming much confused.

The light of a fire ashore showed me the ironclad made fast to the wharf, with a pen of logs around about 30 feet from her side.

Passing her closely, we made a complete circle so as to strike her fairly, and went into her bows on. By this time the enemy's fire was very severe, but a dose of canister at short range served to moderate their zeal and disturb their aim. Paymaster Swan, of the *Otsego*, was wounded near me, but how many more I know not. Three bullets struck my clothing, and the air seemed full of them.

In a moment we had struck the logs, just abreast of the quarter port, breasting them in some feet, and our bows resting on them. The torpedo boom was then lowered and by a vigorous pull I succeeded in diving the torpedo under the overhang and exploding it at the same time that the *Albemarle's* gun was fired. A shot seemed to go crashing through my boat, and a dense mass of water rushed in from the torpedo, filling the launch and completely disabling her.

The enemy then continued his fire at 15 feet range, and demanded our surrender, which I twice refused, ordering the men to save themselves, and removing my own coat and shoes. Springing into the river, I swam, with others, into the middle of the stream, the rebels failing to hit us.

The most of our party were captured, some were drowned, and only one escaped besides myself, and he in another direction. Acting Master's Mate Woodman, of the *Commodore Hull*, I met in the water half a mile below the town, and assisted him as best I could, but failed to get him ashore.

Completely exhausted, I managed to reach the shore, but was too weak to crawl out of the water until just at daylight, when I managed to creep into the swamp, close to the fort. While hiding a few feet from the path, two of the *Albemarle's* officers passed, and I judged from their conversation that the ship was destroyed.

Some hours' traveling in the swamp served to bring me out well below the town, when I sent a negro in to gain information and found that the ram was truly sunk.

Proceeding through another swamp, I came to a creek and captured a skiff, belonging to a picket of the enemy, and with this, by 11 o'clock the next night, had made my way out to the *Valley City*.

Acting Master's Mate William L. Howorth, of the *Monticello*, showed, as usual, conspicuous bravery. He is the same officer who has been with me twice in Wilmington harbor. I trust he may be promoted, when exchanged, as well as Acting Third Assistant Engineer Stotesbury, who, being for the first time under fire, handled his engine promptly and with

coolness. All the officers and men behaved in the most gallant manner. I will furnish their names to the Department as soon as they can be procured.

The cutter of the *Shamrock* boarded the *Southfield*, but found no gun. Four prisoners were taken there.

The ram is now completely submerged, and the enemy have sunk three schooners in the river to obstruct the passage of our ships.

I desire to call the attention of the admiral and Department to the spirit manifested by the sailors on the ships in these sounds. But few men were wanted, but all hands were eager to go into the action, many offering their chosen shipmates a month's pay to resign in their favor.

I am, sir, very respectfully, your obedient servant,

W. B. CUSHING,
Lieutenant, U. S. Navy.

REAR-ADMIRAL D. D. PORTER,
Commanding North Atlantic Squadron.

The name of the man who escaped is William Hoftman, seaman, on the *Chicopee*. He did his duty well, and deserves a medal or honor.

Respectfully,

W. B. CUSHING,
U. S. Navy.

REPORT OF ACTING ENSIGN GAY, U. S. NAVY.

PORTSMOUTH, N. H., March 7, 1865.

SIR: In obedience to your order I have returned to my home, and submit the following report of my capture: On the 26th of October, 1864, Lieutenant Cushing came alongside of the U. S. S. *Otsego*, then on picket duty near the mouth of the Roanoke River, with picket boat No. 1, to proceed up to Plymouth to endeavor to destroy the rebel ram *Albemarle*. Wishing to act a part in the expedition, I immediately offered my services, which were accepted. Having made all necessary preparations we left the U. S. S. *Otsego* at 11 p. m., having the U. S. S. *Shamrock's* cutter in tow, with 2 officers and 10 men. We then proceeded up the river. Having passed the pickets on the *Southfield* and Fort Race without being discovered, we came within hailing distance of the ram. The cutter was then cast off and ordered to proceed back and capture the pickets on the *Southfield*. Seeing a light ahead, which we took to be on board the *Albemarle*, we approached carefully under full speed, but on coming parallel with the light [it] showed us the ram astern of us. On turning around we were hailed from the ram. We made no answer. We were hailed again, making no answer, but still getting in a fair position.

The next call was not so pleasant, for we were discovered, and the grape and canister began to play on our small craft in rapid succession, which was returned by our 12-pounder. At the same time Lieutenant Cushing sang out with several others, "Leave the ram, or I'll blow you to pieces!" Having backed our boat sufficiently to get headway enough on

her to jump the log pen which encircled the ram, we succeeded in jumping the logs and lowering the torpedo boom, and by a vigorous pull Lieutenant Cushing succeeded in exploding the torpedo under the port bow of the ram. Everything now was in the greatest of excitement on account of the heavy musketry we were receiving from the ram. Having backed our boat off from the *Albemarle*, we came in contact with the logs which were encircled around her. Finding it impossible to extricate our boat, and being twice ordered to surrender, Lieutenant Cushing gave the order not to surrender, at the same time sang out, " Men, save yourselves," and immediately sprang overboard, several others following the example. I had not proceeded far from the boat when I fell in with Acting Ensign William L. Howorth on a log, unable to proceed farther without assistance. Having a life preserver with me, I gave it to him and returned to the boat to procure another, not knowing how far I might have to swim, and at the same time I destroyed two boxes of ammunition and several carbines. I had not gone far the second time when I found myself chilled, and after a severe struggle I regained the circle of logs, where I found several of the crew, with a boat from the ram in charge of Lieutenant Roberts. We were all taken on shore and marched to the prison, where we remained until our gunboats made their approach up the river. We were then marched to Tarboro, N. C., a distance of 60 miles, [at] which place we arrived on the 2d of November, being very tired and feet badly swollen. On the 3d we were sent to Salisbury, where we arrived on the 5th. After marching about 2 miles we arrived at the stockade, where we were enclosed with some 10,000 prisoners. Here we suffered immensely for the want of shelter from the inclemency of the weather and also for provisions, as our fare was very poor, being one-half pint of meal per day, which was very inconvenient on account of having no cooking utensils. On the 13th we were sent to Danville, where [we] arrived on the 14th. Here we were placed in a brick building with about 500 army officers. This place we found to be more comfortable, as we were sheltered from the weather, but still not having a blanket or cover of any kind, which made it very severe for us. Our ration here was a piece of corn bread, 4 inches long, 2 wide, and 1½ thick; this consisted of our day's ration. On the 11th of December we were sent to Richmond, Va., and confined in Libby Prison. There we found the treatment much the same as at Danville. On the 21st of February, 1865, we were paroled, and arrived at Cox's Landing the same afternoon and repaired on board of the flag-of-truce steamer *New York*, where we received a bountiful supply [of] edibles. Hoping this will meet with your approbation,

I remain, your obedient servant,

THOMAS S. GAY,
Acting Ensign, U. S. Navy.

HON. GIDEON WELLES,
Secretary of the Navy, Washington, D. C.

COPY OF LETTER FOUND IN THE POST-OFFICE AT PLYMOUTH, N. C., NOVEMBER 1, 1864.

U. S. S. "ALBEMARLE," PLYMOUTH, N. C., October 29, 1864.

ESTEEMED FRIEND: I received your kind epistle of the 20th instant, finding me lingering under a severe attack of the fever. I am now up and about again, nearly as well as ever. They are sending out expeditions every now and then. We captured a Yankee yawl boat. It is supposed we killed nearly all of her crew, consisting of about eight men. But the most awful thing of all (perhaps you will hear of it before this reaches you) is that a Yankee torpedo boat steamed up the river Thursday night, and about 3 o'clock Friday morning ran into the *Albemarle*. The torpedo bursting, blew a great hole in her some 6 feet long, sinking her almost instantly. She is now lying at the bottom of the Roanoke River. The crew lost everything they had, bed clothing and everything. Some lost their hats and shoes, and some even came out in their shirts and drawers, barefooted. We are in an awful condition. I believe they are going to hold the place to the bitter end. Captain Warley says he intends to fight as long as there is a man left (this is all gas). I never did witness such an uproar before in my life. Troops were hurrying to and fro, expecting every moment to meet in battle dread. But, fortunately, there has been no attack, though there is no telling how soon we may see a man-of-war steaming up the river, belching forth fury in her mad career, carrying in her front the token of devastation and ruin. We are going to take command of one of the forts on the river.

* * * * * * * * * * *

Direct your letter to Plymouth, N. C., care of Captain Warley.

I remain, as ever, your sincere friend,

E. K. L.

GENERAL ORDER OF REAR-ADMIRAL PORTER, U. S. NAVY, ANNOUNCING THE DESTRUCTION OF THE RAM.

GENERAL ORDERS,

No. 34.

NORTH ATLANTIC SQUADRON, FLAGSHIP "MALVERN," November 5, 1864.

Nothing stimulates the energy and zeal of officers and men more than a proper appreciation of their services. It is always my desire to give full credit to all officers and men under my command who may distinguish themselves and reflect credit upon the naval service. It is right that the creditable work of an officer should be made known to those serving in the same squadron.

It affords me pleasure to inform the officers and men of the squadron under my command that the rebel ram *Albemarle*, which has for so long a time kept a large force of vessels employed to watch her, has been destroyed by Lieutenant William B. Cushing, who, in this hazardous enterprise, has displayed a heroic enterprise seldom equaled and never excelled. In the face of a watchful enemy, and under a heavy fire of musketry and great guns, he went right into the ram *Albemarle* and blew her up, his own boat being destroyed by one of the enemy's shot. To say

nothing of the moral effect of this gallant affair, the loss of this vessel to the rebels cannot be estimated. It leaves open to us all the Albemarle Sound and tributaries, and gives us a number of vessels for employment elsewhere (hitherto kept to watch the ram), which has been a great source of annoyance to the vessels in the sound. The gallant exploits of Lieutenant Cushing previous to this affair will form a bright page in the history of the war, but they have all been eclipsed by the destruction of the *Albemarle*. The spirit evinced by this officer is what I wish to see pervading this squadron. He has shown an absolute disregard of death or danger, and will no doubt be suitably rewarded by the Government, which reward he well deserves. Opportunities will be offered to all those who have the energy and skill to undertake like enterprises; and 20 volunteers are wanted at this moment to perform a like service. The chances are death, capture, glory, and promotion.

DAVID D. PORTER,
Rear-Admiral, Commanding North Atlantic Squadron.

To be read to the officers and crew assembled on the quarter-deck of each vessel in this squadron.

NOTE.—In response to General Orders, No. 34, requesting twenty volunteers for extra hazardous duty, 77 officers, 149 enlisted men, and the entire ship's company of the U. S. S. *Tuscarora* volunteered their services.—COMPILERS.

LETTER OF COMMENDATION FROM THE SECRETARY OF THE NAVY TO LIEUTENANT CUSHING, U. S. NAVY.

NAVY DEPARTMENT, November 9, 1864.

SIR: Your report of October 30 has been received, announcing the destruction of the rebel ironclad steamer *Albemarle* on the night of the 27th ultimo at Plymouth, N. C.

When last summer the Department selected you for this important and perilous undertaking, and sent you to Rear-Admiral Gregory at New York to make the necessary preparations, it left the details with you to perfect. To you and your brave comrades, therefore, belongs the exclusive credit which attaches to this daring achievement. The destruction of so formidable a vessel, which had resisted the continued attack of a number of our steamers, is an important event, touching our future naval and military operations. The judgment, as well as the daring courage displayed, would do honor to any officer, and redounds to the credit of one 21 years of age.

On four previous occasions the Department has had the gratification of expressing its approbation of your conduct in the face of the enemy, and in each instance there was manifested by you the same heroic daring and innate love of perilous adventure—a mind determined to succeed and not to be deterred by any apprehensions of defeat.

The Department has presented your name to the President for a vote of thanks, that you may be promoted one grade, and your comrades also shall receive recognition.

It gives me pleasure to recall the assurance you gave me at the commencement of your active professional career that you would prove yourself worthy of the confidence reposed in you and of the service to which you were appointed. I trust you may be preserved through further trials, and it is for yourself to determine whether, after entering upon so auspicious a career, you shall by careful study and self-discipline be prepared for a wider sphere of usefulness on the call of your country

Very respectfully,

GIDEON WELLES,
Secretary of the Navy.

LIEUTENANT W. B. CUSHING, U. S. Navy, Washington, D. C.

LETTER OF THE PRESIDENT OF THE UNITED STATES TO CONGRESS, RECOMMENDING A VOTE OF THANKS TO LIEUTENANT CUSHING, U. S. NAVY.

TO THE SENATE AND HOUSE OF REPRESENTATIVES: In conformity to the law of the 16th July, 1862, I most cordially recommend that Lieutenant William B. Cushing, U. S. Navy, receive a vote of thanks from Congress for his important, gallant, and perilous achievement in destroying the rebel ironclad steamer *Albemarle* on the night of the 27th October, 1864, at Plymouth, N. C. The destruction of so formidable a vessel, which had resisted the continued attacks of a number of our vessels on former occasions, is an important event touching our future naval and military operations, and would reflect honor on any officer, and redounds to the credit of this young officer and the few brave comrades who assisted in this successful and daring undertaking.

This recommendation is specially made in order to comply with the requirements of the ninth section of the aforesaid act, which is in the following words, viz:

"That any line officer of the Navy or Marine Corps may be advanced one grade, if, upon recommendation of the President by name, he received the thanks of Congress for highly distinguished conduct in conflict with the enemy, or for extraordinary heroism in the line of his profession."

ABRAHAM LINCOLN.

WASHINGTON CITY, December 15, 1864.

RESOLUTION TENDERING THE THANKS OF CONGRESS TO LIEUTENANT CUSHING AND TO THE OFFICERS AND MEN WHO ASSISTED HIM IN THE DESTRUCTION OF THE C. S. RAM "ALBEMARLE."

That the thanks of Congress are due, and are hereby tendered, to Lieutenant William B. Cushing, of the United States Navy, and to the officers and men under his command, for the skill and gallantry displayed by them in the destruction of the rebel ironclad steamer *Albemarle* at Plymouth, North Carolina, on the night of the twenty-seventh of October, eighteen hundred and sixty-four.

Approved December 20, 1864.

After the destruction of the *Albemarle,* Cushing was placed in command of Rear-Admiral Porter's flag steamer *Malvern,* and led the squadron to its attacks on Fort Fisher. There Cushing's active services were so urgently needed that he was again placed in command of his staunch vessel the *Monticello* and rendered excellent service. The following contemporaneous newspaper account is descriptive of the work done by Cushing in sounding for anchorage of the Union vessels in the first attack on Fort Fisher. Cushing considered this his most hazardous experience and has stated that he was under fire for six hours.

(Newspaper extract—*Philadelphia Inquirer.*)

At one o'clock a small boat was launched from the *Malvern,* containing Lieutenant William B. Cushing, he who sunk the *Albemarle,* Master's Mate Horton, of the *Malvern,* and thirteen seamen. The little boat carried the blue and white pennant of a commanding officer, to which Lieutenant Cushing is entitled. The frail craft headed toward the fort, and the thirteenth stood in the bow, casting a lead, and announcing the soundings. Master's Mate Horton sat in the stern noting the depths, and Lieutenant Cushing directed the course to be rowed and sounded. For ten minutes the rebels seemed paralyzed with this audacious piece of coast surveying, and then they trained their guns on the boat and fired, the first shot striking the water not more than fifty feet from the boat.

Not the least disturbed was Cushing or his men; the sailors rowed steadily, the lead was thrown, the soundings noted, as if shot and shell were not dropping all around them, and at times splashing them with water which they cast high in the air.

Steadily forward sped the little boat. Under the very muzzles of Fisher's guns were the soundings taken. When a biscuit might be tossed from the boat to the beach, Lieutenant Cushing signalled his men to cease rowing, and he stood up in the stern of his frail craft and took a cool and deliberate survey of the fort. There he stood, a glittering target for the rebel gunners, for he wore every stripe of lace to which his rank entitles him. The rebel gunners deemed him incorrigible or respected his bravery; but what is more likely, they saw more Yankee audacity in the distance.

At the attack by assault on the fort on January 15, 1865, and after the repulse of the naval party, Cushing organized a field hospital and also relieved the army forces in the trenches, thereby releasing these forces and enabling them to join in the attack which resulted in the capture of that stronghold. The assault was led by Cushing, Preston and Porter, and is described in Harper's Magazine in an article regarding the service of Lieutenant B. H. Porter as follows:

(Extract from *Harper's Magazine.*)

Accompanied by two of his best friends and two of the most heroic young men the war has developed—Lieutenants W. B. Cushing and S. W. Preston—he took his place at the head of the column. . . . The only survivor of the three young men, Lieutenant W. B. Cushing, the hero of the *Albemarle* capture, whose fame can never die, thus described the scene which ensued: "Ben looked grave and determined. We were under a terrific fire and the men commenced to get confused. Ben threw himself to the front, flag in hand, and the charge went on. At the palisade by the ditch that surrounds the fort, Ben fell shot through the breast. His last words were, 'Carry me down the beach.' Four of the *Malvern's* and *Monticello's* men raised him and tried to comply. Two were killed. He waved the others aside with a last motion and died."

After the fall of Fort Fisher he rendered extremely hazardous service in taking up torpedoes, repeating his daring examination of the Cape Fear River and its inner defensive works. His shrewd and skillful work in luring in and capturing the blockade-running steamers *Stag* and *Charlotte* is a story by itself, and his construction of a fierce looking "mock monitor" caused the Confederates to evacuate a strong earth-work and caused many a hearty laugh among the sailors of the fleet.

The war was over. In four years Cushing had risen from the position of "bilged" midshipman to the rank of lieutenant-commander, and to a fame that is unique in our navy. The casualty book of the Navy Department contains no mention that he was ever wounded, yet no other man ever encountered the dangers that he passed and survived them, preserved as if by a succession of miracles and sustained through all his trials by a firm faith in the eternal goodness and justice of God.

(CONCLUDED IN SEPTEMBER.)

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

PANAMA CANAL TOLLS.

By REAR-ADMIRAL CHARLES H. STOCKTON, U. S. Navy.

In regard to the status of canals in general, Prof. John Bassett Moore, in Vol. 3, p. 268, of his monumental Digest of International Law, published in 1909, says:

> While a natural thoroughfare, although wholly within the dominion of a government, may be passed by commercial ships, of right, yet the nation which constructs an artificial channel may annex such conditions to its use as it pleases.

Oppenheim, in his latest edition (Vol. 1, p. 248), says upon this subject:

> That canals are parts of the territories of the respective territorial states is obvious from the fact that they are artificially constructed waterways.

The latter author previously made a statement as follows (Vol. 1, p. 231):

> The supreme authority which a state exercises over its territory makes it apparent that on one and the same territory can exist one full sovereign state only. Two or more full-sovereign states on one and the same territory are an impossibility. The following five cases, of which the Law of Nations is cognizant are apparent, but not real, exceptions to this rule. . . . . (The fourth only is quoted.)
>
> (4) The *fourth* case is that of a piece of territory of which the use, occupation, and control is in perpetuity granted by the owner—state, to another state with the exclusion of the exercise of any sovereign rights over the territory concerned on the part of the grantor. In this way the Republic of Panama transferred in 1903, to the United States of America a ten-mile wide strip of territory for the purpose of constructing, administrating, and defending the so-called Panama Canal. In this case the grantor retains only in name the property of the territory, the transfer of the land concerned is really cession all but in name, and it is certain that only the grantee exercises sovereignty there.

Of course such cessions and such sovereignty can be affected by previous treaties still in force concerning the use of the acquired territory for the purpose of a canal and its incident artificial navi-

gation between two given seas or bodies of water. In 1850 Great Britain and the United States, in the Clayton-Bulwer treaty of Washington, stipulated as between these nations the free navigation and neutralization of a canal between the Pacific and the Atlantic oceans then proposed to be constructed by the way of the River San Juan de Nicaragua and the lakes of Nicaragua and Managua. In 1881 the building of a canal through the Isthmus of Panama was taken in hand under the auspices of a French company, but in 1888 the works were stopped in consequence of the financial collapse of the company. After this the United States revived the project of a canal by the way of San Juan River and the lakes of Nicaragua. In view of the possible completion of this canal, Great Britain and the United States signed, on February 5, 1900, the Convention of Washington, which stipulated free navigation on, and the neutralization of, the proposed canal as set forth for the Suez Canal by the Convention of Constantinople of 1888. Ratification of this convention was wisely refused by the Senate of the United States. In the following year, however, on November 18, 1901, another treaty known as the Hay-Pauncefote treaty, was signed and duly ratified by the Senate of the United States. This treaty, between Great Britain and the United States alone, applies to a canal between the Atlantic and Pacific oceans by whatever route may be expedient and supersedes the Clayton-Bulwer treaty specifically in its *first* article, as that treaty was practically otherwise a perpetual treaty. The *second* article of the treaty reads as follows:

> It is agreed that the canal may be constructed under the auspices of the government of the United States, either directly at its own cost, or by gift, or loan of money to individuals or corporations, or through subscription to or purchase of stock or shares, and that, *subject to the provisions of the present treaty*, the said government shall have and enjoy all the rights incident to such construction, as well as the exclusive right of providing for the regulation and management of the canal.

It will be necessary also to give as pertinent to the matter under discussion the preamble and first paragraph of the *third* article of the treaty which follows and which reads that:

> The United States adopts, as the basis of the neutralization of such ship canal, the following rules, substantially as embodied in the Convention of Constantinople, signed October 29, 1888, for the free navigation of the Suez Canal, that is to say:
>
> 1. The canal shall be free and open to the vessels of commerce and of war of all nations observing these rules, on terms of entire equality, *so*

that there shall be no discrimination against any such nation, or its citizens or subjects, in respect of the conditions or charges of traffic or otherwise. Such conditions and charges of traffic shall be just and equitable.

The reading of these articles, with the words italicized by the present writer, makes it evident that there shall not be any discrimination in favor of any country or person, even in favor of that country which constructs and owns the canal, but which of its own volition yields any claim for preference. There can be, however, as I propose farther on, discrimination as to certain kinds of navigation provided that within that kind of navigation there shall be no national or individual discrimination. There exists within the laws of the United States, as within the statutes of several other maritime countries, two kinds of classification of trade under which its vessels are placed, known as the coasting or coastwise trade and foreign commerce or trade. With us as with several other countries the trade known in French as "cabotage" and with us as the coasting trade, is reserved to vessels flying the flag of the nation whose coasts are concerned. Foreign trade is of course opened to vessels of all flags and all nations. It is my belief that this discrimination of coastwise, as distinguished from foreign, trade should alone distinguish between the tolls or charges for traffic in the management of the Panama Canal. In order, however, to comply strictly with the terms of the Hay-Pauncefote treaty the charges under each classification should, though differing as to class, be the same to all vessels of all nations engaged in the same class of commerce. To make this just and effective, it would follow that our navigation laws should be changed so that foreign vessels be allowed to enter into our coastwise trade between the Atlantic and Pacific coasts, by the way of the canal, and to carry the matter still farther in its impartiality, that merchants and ship owners of the United States be allowed to purchase foreign vessels and place them under the American flag under the same conditions and privileges as if they were vessels built in the shipyards of the United States. Following these rules there would be no danger as to the railways of the United States controlling the coastwise trade of the United States, via the Isthmus of Panama, as they do now, and there would be no danger of the withholding of capital for the construction and management of steamers for this coastwise trade as has been already threatened. The trade would be opened to the world and be beyond the control of any money, railway or shipping trust.

There is a natural division in the coasting trade of the United States, one portion only being necessarily changed in status, by the creation of a minimum toll, by the admission of foreign vessels and finally by a removal of a prohibition of purchase and transfer to the American flag of vessels built outside of the United States. This portion should be known as the coastwise trade of the United States via the Panama Canal. It would include such trade from the Atlantic and Gulf ports of the United States to the Pacific ports of the United States, not only those to continental ports, like those of California, Oregon, Washington and Alaska, but to the insular possessions of Hawaii and the Philippines as well as the smaller insular ports like Guam and Tutuila. This coastal trade very similar to what is known in French as the "Grand Cabotage" is now restricted by law to American vessels. The other coastal trade known in French as the "Petit Cabotage" could still be reserved to vessels that are American built and be confined to stretches of one coast alone on each side; that is, from ports at such points as Portland, Maine, and Galveston and New Orleans and New York on the Atlantic side, and ports on the Pacific side from San Diego to the ports of Puget Sound and Alaska as extremes. Upon the latter coastal trade, or petit cabotage, the present rules of coast trade would apply while the coastwise trade via the Panama Canal would be made so free and open that the world's shipping could enter so as to break down any railway control or monopoly.

There is another feature to be observed in connection with the coastwise trade of the United States via the Panama Canal. If it should have the present restrictions, the same restrictions that are now applied so far as shipping is concerned, it would be a trade denied to other nations in time of peace and hence under the theory and practice of some nations it would place the neutrals which might be disposed, or secured, to engage in it, in time of war, to capture, by a powerful naval belligerent, under what is known as the Rule of War of 1756, and hence this trade would cease to exist. Great Britain and Germany with more powerful navies than our own could command the neighboring seas and hence bring this trade to a standstill. But as a trade open to other nations in time of peace, neutral shipping would be free from capture under that rule in war time and this most important of trades would go on freely at all times.

Thomas J. Lawrence (p. 668, Principles, etc., of International Law, 4th edition) says that:

> Great Britain backed by several important maritime powers still holds that if a belligerent throws open in time of war, to neutrals, a coasting or colonial trade which it confined to its own subjects in time of peace, its foe may treat all neutral merchantmen who take advantage of the permission as enemy vessels. Another group of powers, headed by the United States, holds strongly to the contrary opinion; and unless a settlement is soon reached, the question may become acute and dangerous in a great maritime war.

Great Britain presented a memorandum in the London Naval Conference favoring the doctrine of the war of 1756 as to colonial and coasting trade but it met with opposition, especially from the United States, France and Holland, to the extent that the matter was left unsettled but alluded to in the 2d paragraph of Art. 57 of the Declaration of London, as follows:

> The case where a neutral vessel is engaged in a trade which is closed in time of peace, remains outside the scope of, and is in no wise affected by this rule.

Hence each maritime power is at liberty to act as it pleases in war time and there is nothing to prevent any power from capturing neutral as well as enemy merchantmen, engaged in the coastwise trade via the Panama Canal so long, as is now the case, that foreign merchantmen are denied the right to enter that trade in time of peace.

It may and probably will be urged that it is necessary to retain this coastwise trade via Panama Canal to build up a merchant marine for the United States. In answer it can be stated that for over fifty years this trade has been in the hands of American built merchantmen without having had any material results in the creation of an American merchant marine. In fact our mercantile marine plying on and off our coast has been mainly a subsidiary to our great railway systems, with freight charges so arranged as not to affect its land freight charges when it comes in competition therewith, and really either to feed the lines alone or to give them advantages over competing railway systems. It is this part railway, part water transportation that gives such a controlling situation in trans-continental trade to the Southern Pacific Railway, from New York to New Orleans or Galveston by water and the remaining portion by land in a climate and with a mileage which tends to much profit.

With a minimum toll to all countries for the coastwise trade, with a competition beyond the reach of railway or railway bankers, and with an opportunity of securing the benefit of cheap construction outside of the United States and with the assurance of free transit in war time under neutral flags, this coastwise trade via the Panama Canal opens an opportunity for the development of our Pacific coast by water route which is beyond the possibility of attainment in cheapness, in time and in safety in any other way. Above all there would be no discrimination in tolls against any country or against any citizen or subject thereof.

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THE BAGDAD RAILWAY AND WHY IT IS OF INTEREST TO THE UNITED STATES.

By CAPTAIN ALBERT GLEAVES, U. S. Navy.

The Bagdad Railway connecting Constantinople with the Persian Gulf when completed will stand a "brilliant second" on the list of achievements of the last fifty years, and to quote the *North German Gazette* (March 22d), "with proud joy we shall then be able to look upon a new monument of German work, German application and stubborn German enterprise." It may seem at first glance that the United States has but little interest in the Bagdad Railway, aside from that interest which every educated man must have in an enterprise of such magnitude. As a matter of fact, however, this country has a very definite and distinct concern in Germany's adventures in Asia Minor—the reason is not difficult to discover—a railroad from Constantinople to the Persian Gulf via Bagdad, under the control of one Power means not only monopoly of trade by that Power, but sooner or later colonization also. Now it is fairly certain that, as pointed out recently in the *Spectator,* at this moment Germany is not ready to undertake over-sea expansion; until her fleet can be released from her own coasts she cannot have distant colonies, for colonies must be protected, and in view of the political situation in Europe, Germany has no ships to spare for that purpose. But while her colonization schemes must be held in abeyance for this reason, the tide of emigration is only checked temporarily. But when it flows again, it will be a matter of much interest to us whether it sets westward toward South America or eastward to Asia Minor. Its bearing on our navy strategy is apparent.

The United States has two great principles to uphold, the policy of the Monroe Doctrine and the integrity of the Panama Canal. For nearly one hundred years the Monroe Doctrine has been the barrier to which those nations most concerned have been loath

to accord official recognition, and threats against it have more than once brought the United States to the brink of war. Our position, however, has been so firm and consistent that it is probable that the proposition is at least tacitly accepted. At any rate England is said to have formally recognized our great policy that the American Continent is for Americans. The only other Power from which there has been reason to feel great apprehension on this point is Germany, and this was due to the prevalent idea that her emigration to South America was of such an extent that she would attempt to establish territorial sovereignty over her colonies that had sprung up there as an overflow for her greatly increasing population.

Prince Von Bülow once said that Germans multiply like hares. As a matter of fact the population of Germany has increased from forty-one millions in 1870 to more than sixty millions in 1905; the annual increase is 900,000. Mr. Ellis Barker in his *Modern Germany* says that only 20,000 to 30,000 yearly emigrate, and that immigration is actually three or four times larger than emigration. It is evident from these figures that an outlet for such a teeming population will soon become imperative.

There can be no doubt that for many years the Pan-Germans looked to South America as the logical field for their colonial ambitions, but these dreams of a South American territory could only be realized by a violation of the Monroe Doctrine, and Germany had no desire to quarrel with the United States. If we consider the number and extent of the German population in South America, I believe that it will be accepted that the question of German colonization is not now sufficient to cause anxiety to the United States. If this is true, the fact is one of great importance when considered in connection with our naval policy.

It is worth mentioning that Brazil also has been sensitive on the subject of German colonization in the Western Hemisphere, and it was thought by some writers that the two big Brazilian dreadnoughts were built as a warning that permanent occupation or control of Brazilian territory would not be tolerated. It is now nearly one hundred years since the first German colony was established in South America (at Rio do Sol in 1824), and although Germany had invested in Brazil alone, in 1900, more than $150,000,000, the absorption of her colonists to a greater or less extent by the natives has not been encouraging to German hopes. In

1905 the total German population in South America was 653,500. In the States of Rio do Sol, Santa Catarina, and Parana (1899) 300,000 of these were German speaking, but according to Consular Reports not more than 200 were citizens of the German Empire. The greatest number of emigrants in any one year to South America was 2,500 in 1906. These figures are only approximate, as it is impossible to differentiate between Germans of long residence in the Republics, Germans born within the Republics, and Germans naturalized there. There is no custom of naturalization such as obtains in the United States. All children born on the soil of Latin American countries of German parentage are considered natives in the sense of the word that they are amenable to certain local laws, although they still remain German both by breeding and culture. Where then will Germany plant her colonies? She might expand in New Guinea, on the West Coast of Africa, in the Belgian Congo, China, or lastly in Asia Minor, but there are strong reasons to believe that Asia Minor is the serious objective of her industrial and colonial ambitions. It is evident from Germany's relations with Turkey, and the course of conciliation she has pursued for the last thirty years with the Ottoman Empire, that she contemplates Asia Minor as the logical territory to receive her surplus population, and to develop her trade and commerce, and there can not be much doubt that one of the most eagerly hoped for results of the construction of the Bagdad Railroad is the colonization by Germans of Asia Minor and probably also the neutral zone of Persia. As we have seen the flow of emigration to South America has already been checked; if it is diverted from the shores of South America towards the Middle East, it will probably never run back, and this menace to the Monroe Doctrine will disappear with the opening of the great German trunk line which is to connect Hamburg with the fertile fields of Syria and Mesopotamia.

In regard to our trade relations with Germany, the Bagdad Railroad cannot fail to exert a great influence. For many years after the war with France, Germany found the United States a practically inexhaustible market for the sale of her manufactured products, but the McKinley Bill in 1890 and the Dingley Tariff practically crushed that trade, and encouraged home industries to such an extent that in the course of a few years Germany found the scales turned, and instead of selling her goods in the United

States, American products were successfully competing with German stuff in the shops of Berlin. Now the Bagdad Railroad will open up a great market in Asia Minor for German goods, and it cannot be doubted that American and other foreign goods will be subjected to a high Turkish tariff, just as by the last convention it was proposed to tax all British importations four per cent, with the result that instead of English trade predominating as it does now, it will practically all pass into the hands of the Germans. Our own trade with Asia Minor is considerable as shown by the following table:

Year	Total Exports
1890	$25,669.00
1900	226,655.00
1910	744,504.00

Year	Total Imports
1890	$2,437,108.00
1900	3,823,371.00
1910	7,664,132.00

Thus while on the one hand the Bagdad Railway will have a tendency to soothe our sensitiveness as far as the Germanization of South America is concerned, it contains great possibilities for friction in our trade relations.

It is an interesting situation.

Let us now consider for a moment how Persia will be affected by the Germanization of Asia Minor.

On March 26, 1907, a Russian squadron composed of the battleships *Cesarvitch* and *Slava* and the cruiser *Bogatyre* arrived at Portsmouth, England, and was received with great enthusiasm. The same month the Dowager Empress of Russia made a visit to the Royal Family in London. These visits indicated complete harmony between the two governments. The English press endorsed this attitude and was practically unanimous in assurances of the sympathies of England with Russia. It was evident that something was going to happen, and the entente between London and St. Petersburg was applauded on all sides. This exchange of felicitations proved to be a prelude to the Anglo-Russian convention which was signed on the 30th of August, 1907. By this agreement Persia was divided into three zones. The northern zone was to be under Russian influence; the southern zone which was bounded on the east and south by India was to be under English influence, and between these two lay the remaining

twenty-eight per cent of Persia, the so-called neutral zone—a Tom Tiddler's ground as one writer has it—where Germany will probably not be slow to enter when her railroad system in Asia Minor is completed, and she can then push her trade into the very heart of Persia. In the language of the convention, "the understanding can only serve to further and promote Persian interests, for henceforth Persia aided and assisted by these two powerful neighboring states can employ all her strength in internal reforms." It may be observed that this clause has been the subject of many humorous cartoons, notably one in a recent *Punch*.

However, Russia and Germany came to an agreement in regard to the railway when the Czar and Emperor met at Potsdam in November, 1910. Mr. Garvin, writing on these *pour parlers* (*Fortnightly Review*, February, 1911) says, "By this understanding Russia secures absolutely her interests in Northern Persia, while Germany is relieved from any fear of Russian opposition to the Bagdad Railway." Russia agreed to build the branch line from just north of Bagdad to Khanikin on the Persian frontier, and Germany agreed not to build any other branch road to any other portion of the north Persian frontier. This branch road from Sadiej to Khanikin is considered to be of the greatest importance, as it will not only receive the tremendous flow of the Shiah pilgrimage, but it will absolutely control trade; furthermore it will be of greatest strategical importance, as a line from Khanikin to Teheran will connect the Russian frontier directly with the Persian Gulf. The vast importance of this road to Turkey as well as to Russia will be appreciated when it is remembered that in the future, with the branch lines to Alexandretta and Aleppo, Turkey will be brought on the flank of Egypt, and also in direct communication with the shores of the Caspian Sea.*

*When the railway gets into Syria, and when the gap between Aleppo and Hamah is bridged, it will constitute a line from the Bosphorus to within fifty miles of our Egyptian frontier at Akaba. It will then be an easy matter for the Turks, or any Continental Power allied with them, to transport three divisions to within striking distance of the Suez Canal. To this we could only oppose the one weak division, practically without artillery, which constitutes the Egyptian Army. It is, therefore, a matter for consideration whether we should not fortify, or at least select, positions covering the Suez Canal, which would enable the Egyptian forces to hold out for three weeks till reinforced from England or Bombay. The presence of Lord Kitchener in Egypt is a guarantee that this matter will not be neglected. (*Army and Navy Gazette*, March 9, 1912.)

In the Potsdam "conversations" it was declared by Germany that she had no political interests in Persia, and that she did recognize Russia's special interests there. Finally Russia assured German commerce in Persia the principle of the open door.

To return now to the Bagdad Railroad. In order to have a clear understanding of the situation it will be necessary to refer to the map. The conception of connecting the Eastern Mediterranean with the Persian Gulf by a railroad dates back to 1836, and since then various routes across Arabia have been proposed. The route finally selected and which is now under construction, although not altogether his original line, was chosen by Von Pressel, a distinguished German engineer. He, like many others, was haunted by the dream of a railroad that would connect Berlin with the ancient city of the Caliphs. This was his great ambition, and it was to be the work of his life. His scheme was to have a great railroad station on the Golden Horn, and another at Haidar-Pascha on the Asiatic side of the Bosphorus; this comprehended a series of tunnels, the most gigantic part of the work being twin tunnels under the Bosphorus.

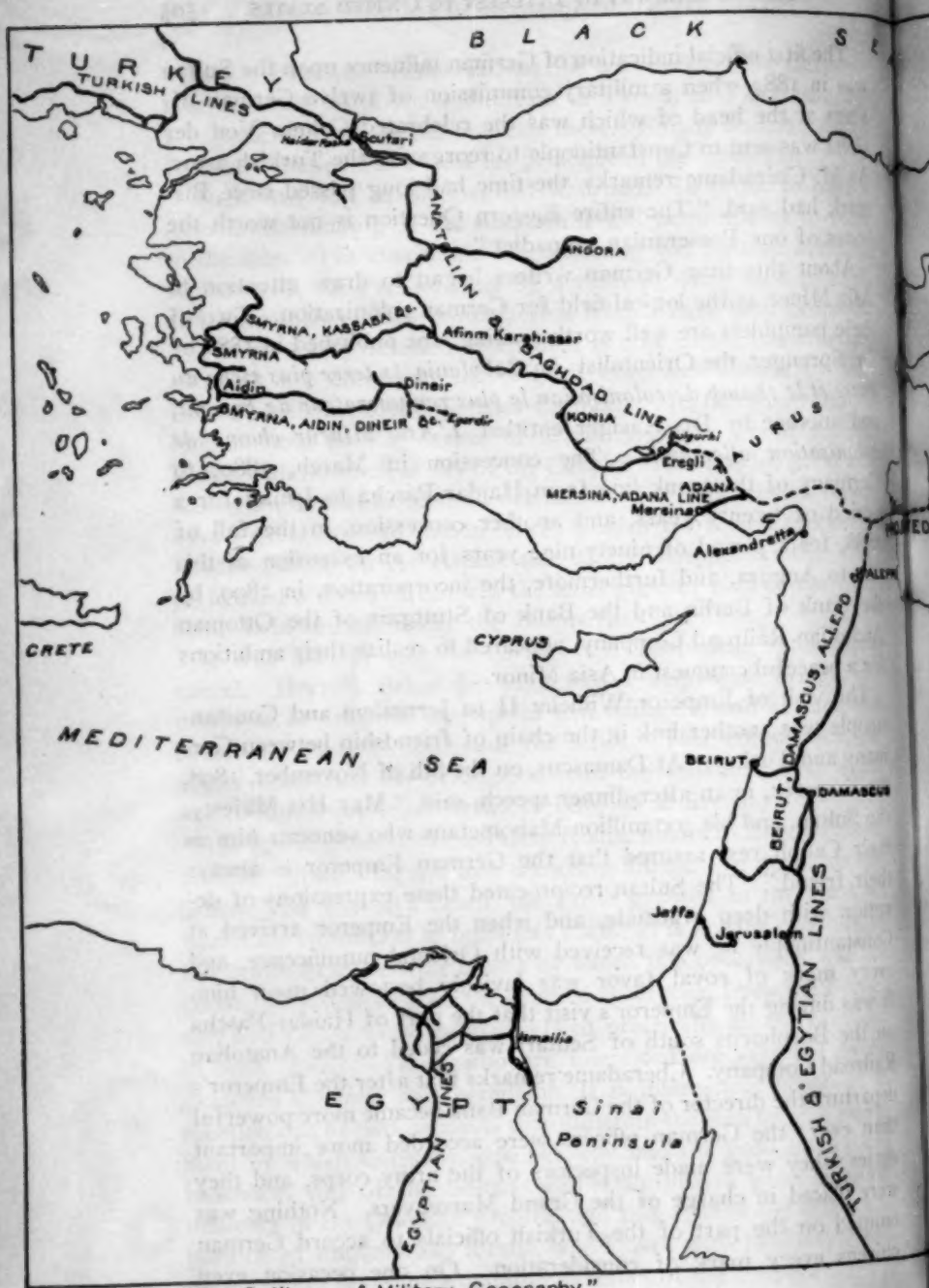
It was also proposed to bridge the Bosphorus rather than tunnel. Herr S. Schneider suggested a suspension bridge, the pillars to be crowned by cupolas and minarets, and at each end armored turrets to command the strait. This enthusiastic engineer completed his description with the statement that trains would run direct from Berlin to Babylon in five days.

The line in general was to run to Konia, thence to Eregli, Adana, Nisibin, Mosul, Bagdad and thence to Busra. In 1902, shortly before Von Pressel's death, the Porte granted to the Bank of Berlin the concession to build this road. It is not the province of this paper to discuss the means by which this concession was obtained, or to comment on the gradual absorption from the French and English by German financiers of practically all the railroads in Asia Minor. Those who are interested are referred to *La Question d'Orient* by Chéradame. It is interesting, however, to mention one or two incidents that illustrate the step by step movement by which Germany won her way into the good graces and beneficent will of the Sultan, and established a predominating influence in the Ottoman Empire, and this against the active opposition of England and Russia, who looked with foreboding and prescient eye upon the expanding schemes of the Emperor.

The first official indication of German influence upon the Sultan was in 1882 when a military commission of twelve German officers at the head of which was the celebrated Colmar Von der Goltz was sent to Constantinople to reorganize the Turkish army. As M. Chéradame remarks, the time had long passed since Bismark had said, "The entire Eastern Question is not worth the bones of one Pomeranian grenadier."

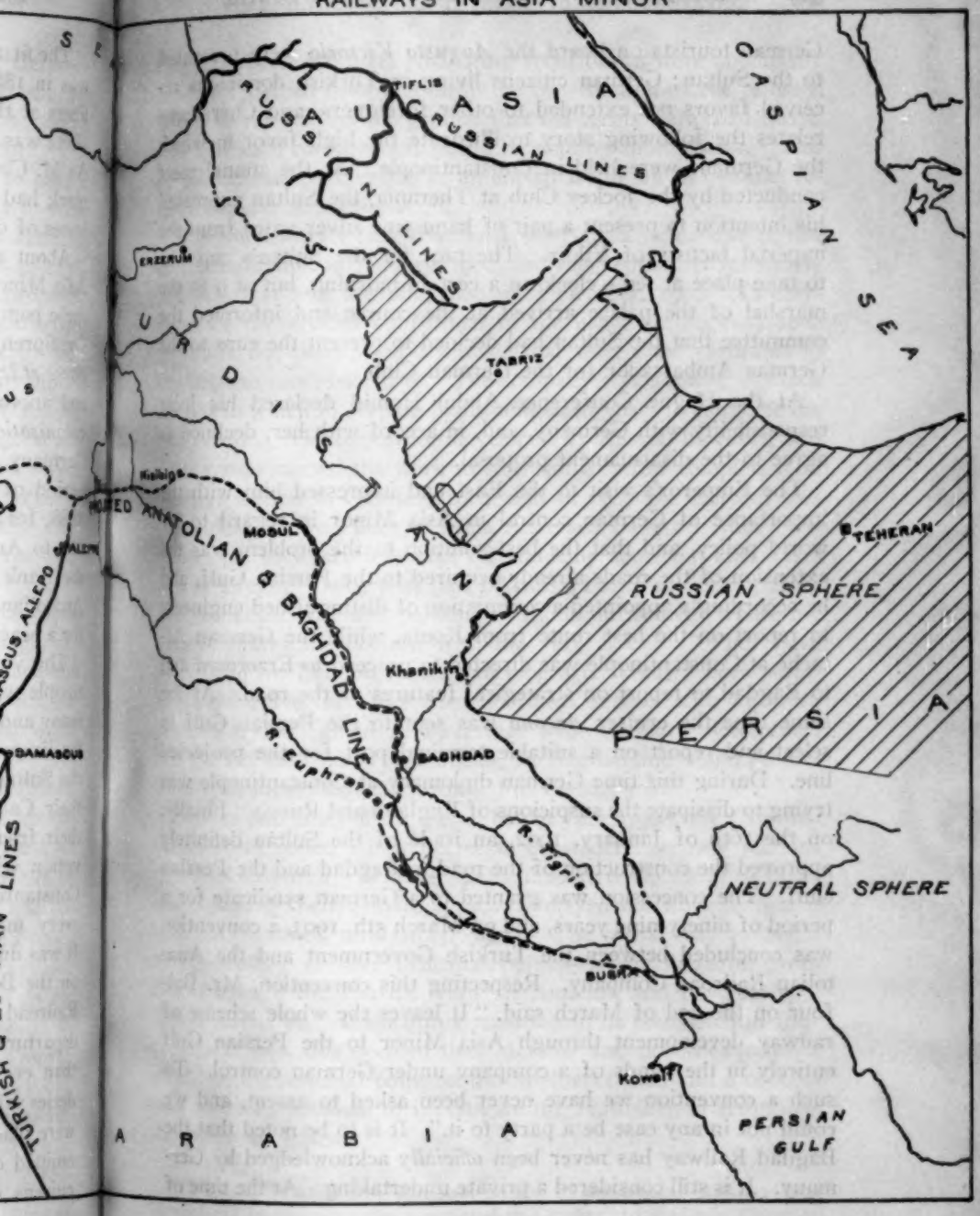
About this time German writers began to draw attention to Asia Minor as the logical field for German colonization. Two of these pamphlets are well worth reading, one published in 1886 by Dr. Sprenger, the Orientalist, *La Babylonia, la terre plus riche du passé et le champ de colonisation le plus remunerateur de present*, and another by Dr. Kaeiger entitled, *L'Asia Mineur champ de colonisation allemande*. The concession in March, 1880, to Germany of the trunk line from Haidar-Pascha to Ismidt for a period of twenty years, and another concession, in the fall of 1888, for a period of ninety-nine years for an extension of this line to Angora, and furthermore, the incorporation, in 1899, by the Bank of Berlin and the Bank of Stuttgart of the Ottoman Anatolian Railroad Company, appeared to realize their ambitions for a peaceful conquest in Asia Minor.

The visit of Emperor Wilhelm II to Jerusalem and Constantinople was another link in the chain of friendship between Germany and Turkey. At Damascus, on the 8th of November, 1898, the Emperor, in an after-dinner speech, said, "May His Majesty, the Sultan, and his 300 million Mahometans who venerate him as their Caliph rest assured that the German Emperor is always their friend." The Sultan reciprocated these expressions of devotion with deep gratitude, and when the Emperor arrived at Constantinople he was received with Oriental munificence, and every mark of royal favor was lavishly bestowed upon him. It was during the Emperor's visit that the port of Haidar-Pascha on the Bosphorus south of Scutari was ceded to the Anatolian Railroad Company. Chéradame remarks that after the Emperor's departure the director of the German Bank became more powerful than ever; the German officers were accorded more important duties; they were made inspectors of the army corps, and they were placed in charge of the Grand Manœuvers. Nothing was omitted on the part of the Turkish officials to accord German citizens every mark of consideration. On one occasion even



Taken from "The Outlines of Military Geography"
by Colonel A.C. Macdonnell, Late Royal Engineers

SKETCH MAP SHOWING
RAILWAYS IN ASIA MINOR



German tourists on board the *Augusta Victoria* were presented to the Sultan; German citizens living in Turkish dominions received favors not extended to other foreigners, and Chéradame relates the following story to illustrate the high favor in which the Germans were held in Constantinople. At the annual meet conducted by the Jockey Club at Therapia, the Sultan expressed his intention to present a pair of handsome silver vases from the imperial factory of Yildiz. The race for the Sultan's cup was to take place at ten o'clock on a certain morning, but at 9.30 the marshal of the palace arrived at the course and informed the committee that the Sultan had decided to present the cups to the German Ambassador for the German Club.

At the Hague Conference Abdul Hamid declared his joint responsibility with Germany, and, in accord with her, declined to agree to the disarmament proposal.

The Emperor's visit to the East had impressed him with the importance of German control in Asia Minor in regard to his world policy, and that the best solution to the problem was the extension of the roads already acquired to the Persian Gulf, and he accordingly appointed a commission of distinguished engineers to report on the best route from Konia, while the German Attaché at Constantinople was directed to proceed to Erzeroum and to Bagdad to report on strategical features of the road. At the same time the cruiser *Arcona* was sent to the Persian Gulf to select and report on a suitable terminal port for the projected line. During this time German diplomacy at Constantinople was trying to dissipate the suspicions of England and Russia. Finally, on the 16th of January, 1902, an iradé of the Sultan definitely approved the construction of the road to Bagdad and the Persian Gulf. The concession was granted to a German syndicate for a period of ninety-nine years, and on March 5th, 1903, a convention was concluded between the Turkish Government and the Anatolian Railroad Company. Respecting this convention, Mr. Balfour on the 23d of March said, "It leaves the whole scheme of railway development through Asia Minor to the Persian Gulf entirely in the hands of a company under German control. To such a convention we have never been asked to assent, and we could not in any case be a party to it." It is to be noted that the Bagdad Railway has never been *officially* acknowledged by Germany. It is still considered a private undertaking. At the time of

this concession overtures emanating from Berlin were unofficially made for British co-operation in the construction of the railway, but were rejected on the ground that the terms were inadequate, and that such co-operation would be nothing more than a junior or subordinate partnership in an enterprise in which German interests would be predominant.

The convention which contained forty-six articles was signed at Constantinople in January, 1902, and was kept secret for nearly one year. It was not published until October, 1902. Twenty-seven of the articles conformed to the usual verbiage of such contracts, but there were seventeen that were most favorable to the German concessionaries. The company was allowed eighteen months in which to prepare plans, and eight years to complete the first section. The opposition developed by Russia, however, and other causes caused the work to stop shortly after completion of the first section in October, 1904, and in 1907 the English correspondent of the *Times* in India traversed the road from Constantinople to where it breaks off suddenly some ten kilometers east of Eregli,* "where its pair of rails gauntly projecting from the permanent way and pointing in dumb amazement where the Taurus shares the horizon with the very skies." "They have now" said the London *Times,* not long afterwards, "been pointing thus for five years to the bewilderment of those who, knowing the country, imagined in 1904 that with Germany determined and Turkey desirous to push ahead, the Bagdad line would go forward with inevitable march toward its distant goal."

Politics had blocked the game, but in June, 1908, the Ottoman Government issued a new decree to construct four new sections of a total length of 516 miles. Difficulties in completing the plans and obtaining their definite approval delayed the work so that it was not resumed until May, 1910. The work was to begin simultaneously at four principal points—from Bulgurhi, from Adana toward the Taurus, from the Amanus, and from Aleppo. It was estimated that the entire road would be completed in four years. It was also decided that Mersine and not Alexandretta would be the terminal point on the Mediterranean, and a concession was also obtained to investigate the feasibility of irrigating the plains of Adana.

*This must be an error. The first section of the Bagdad Railway (200 kilometers) to Bulgurhi was completed in October, 1904 (Daily Consular Reports, January 13, 1910, No. 3684).

By the terms of the concession the Bagdad Railway was to be built in sections of two hundred kilometers lengths (about 125 miles); the estimated cost per kilometer was £7,500 to £8,500, and the Turkish government guaranteed a revenue of 15,500 francs per kilometer. The Germans have been severely criticised for accepting the guarantee, and have been accused of "looting" and "milking" the treasury of the Sublime Porte. Their defense of this charge tends, however, to prove that Turkey received great benefits and an ample return for her financial venture. By building the road in sections it was hoped to complete it more speedily to the Persian Gulf. The first section begins at Konia and extends to Eregli, and this line has been open for several years; the first section being across level country was the easiest to construct, the next two will be the most difficult, piercing at it does the Taurus Mountains, which are said to present as many difficult obstacles as the passes of the Swiss Alps. Another feature of the concession was that nothing should be paid for the line which could be cheaply obtained between Busra and Bagdad; this was to compel the company to complete the line, and in the same connection it was forbidden to do any work on the sections south of Bagdad until the road had been completed to Bagdad.

On the other hand the Porte granted the company the rights to use the government timber lands and quarries. They were authorized to build warehouses, construct quays and make harbours; mines along the line were to have preferential rights, and so many branch lines were granted as to give the Germans practically the monoply of all the trade and traffic of Asia Minor.

These concessions were evidently granted in the spirit of the old law, *quando lex aliquid alicui concedit concidere videtur id sine quo res ipsa esse non potest.*

The Germans also secured a concession from the Ottoman Government to construct a pier at Alexandretta which is to be capable of berthing deep-draft ships; this construction must be completed in four years, and also a pier at Payas, ten miles to the westward. This provides an outlet to the Bagdad Railroad in the Mediterranean by linking it to a branch road to Adana.

Another concession of great importance was a system of irrigation by which the waters of Lake Beychecher and Karaviran will be brought down through gorges of Thartshumla River into

the plains of Karaman and Konia, a distance of two hundred miles, and will convert into a garden the arid lands now traversed by the first section of the Bagdad Railroad.

The road will probably not be completed for several years, but without doubt it will be a *fait accompli*, and its effects will be far reaching, not only locally by increasing and developing the resources of the country, but by its influence upon the political and economical situation, and its effect upon established trade routes. The products of the country watered by the Euphrates and the Tigris, that before the days of rail transportation never reached the coast, will be given access to Beirut, Smyrna and Constantinople.

The road will restore to civilization what was once its most fertile portion, and with the completion of the Wilcocks irrigation scheme which involves contracts amounting to seventy-five million dollars, the ancient and desolate plains of Mesopotamia—"the land between two rivers"—will blossom as the rose of Sharon, as it did in the days of Abraham, and the now cheerless wastes of Syria will respond to the call of civilization. The natives will be rescued from the bondage of poverty, and the robber bands that now prowl the desert will abandon their predatory pursuits for agriculture and trade.

The road will traverse the most ancient civilizations of the world; it will cross the ruins of Babylon and Ninevah, and will bring the Mosques of Bagdad within six days of Westminster Abbey. The line pierces the Taurus mountains just north of the Kiliki Pass through which Alexander the Great marched to the battle of Isus. After winding through the rocky gorges of this range it descends the steep eastern slopes and crosses the plains of Adana. At Adana the road sends out two branches, one to the Mediterranean at Alexandretta and Mersine, passing through Tarsus, the birthplace of St. Paul, the other to Aleppo. The main line continues to the east, descending gradually towards Mesopotamia—along this part of the route the country is naked and covered only with sparse pasturage. At Birijik it crosses the Euphrates River, the head of navigation, thence through the wild and uncultivated regions of upper Mesopotamia, intersecting the old caravan route from the northward, then through Nisibin, one of the oldest and most celebrated cities of Mesopotamia, to Mosul, situated on the right bank of the Tigris on the slopes of

the Kurdustan plateau and opposite the ruins of Ninevah, the capital of Assyria. From Mosul, the line runs along the Tigris River two hundred and twenty-five miles to Bagdad, once the pride of Islam and the intellectual center of the Caliphs, and more than once destroyed in the struggle between the Turks and Persians.

A few miles to the southward of Bagdad the road again crosses the Euphrates, and then sweeping in a wide curve continues to Busra. Between Bagdad and Busra, the line touches Hilleh, the place of pilgrimage of the Shiahs, and then passes through the holy cities of Nedehef and Kerbela, in the first of which is the tomb of Ali, the cousin and son-in-law of Mahomet, and in the latter the tomb of Hussein, the grandson of the Prophet, the rejected prophet of the Shias, who fell in the desperate battle of Kerbela with a spear through his heart, and whose death is annually commemorated on the 10th day of the sacred month of Mohurrum.

This point is to be noted as it will be seen that the road thus situated will transport thousands of Mahometans making their annual pilgrimage to Mecca and Medina. Such a railway would of course not only carry all the present volume of passenger trade, but would increase it many fold. For instance it is now impossible for the hundreds of wealthy Jews and others who live in Bagdad to escape from the city for summer vacations. Though the terrible heat regularly registers 115° to 122° F., the whole population, rich and poor alike, stays and swelters because there is no avenue of escape except the Tigris, which leads to the Persian Gulf and India. (Daily Consular Report.)

It will require but little tact on the part of the officials of the road to spread their influence throughout all these wild regions, which the Germans are so anxious to bring under their influence.

Busra is situated on the Shat-al-Arab River, which is formed by the junction of the Tigris and Euphrates, and before it can be made a port of entry the bar at the mouth of the river will have to be dredged, which would considerably increase the expenses of the road, and for this reason the concessionaires were anxious to make the terminal at Koweit on the Persian Gulf, eighty kilometers from Busra, and at present the principal port of the pearl fisheries, but it is quite certain that England, which already practically controls the river trade between Busra and

Bagdad, will forbid any foreign control of Koweit, which at present is under the protection of the British Crown. "Foreign intrusion in that land-locked sea," says one writer, "will threaten our supremacy in India."

In the construction of this railroad—this 1670 miles of continuous tracks—what is Germany aiming at? What will be the effect on her ultimate relations with Turkey? How will it affect her relations with the other Powers most interested? With minor exceptions, Germany holds and controls all the railroads in Asia Minor. This, in the minds of various English writers, indicates that her main object is to make Asia Minor the chief field of her commercial enterprises and gradually extend this field into Persia and down along the new railroad to the Persian Gulf. But on this subject, Herr Von Gwinner, Governor of the Deutsche Bank, in June, 1909, published for the first time a letter from the concessionaires to the Minister of Public Works in Constantinople, stating that they engaged not to "introduce or install" foreign colonies along the line of the road. An English author in the *Fortnightly Review* (March, 1911) regards "as nonsense this bug-bear of German colonists." On the other hand, according to Von der Goltz Pasha, Abdul Hamid stated to him that the Germans should establish colonies on both sides of the Bagdad line, and that he, the Sultan, would expropriate for their behoof broad belts of fruitful lands on either side. "But not until Germany has had it out with England," to quote again from the *Spectator*, "either at sea or by a peaceful conquest of the sea through ship building on an immense scale" will this over-sea expansion begin, and then, "once in command of the sea, over-sea empire will follow as naturally as harvest follows a ripened crop."

It may not be in the interests of European peace for one nation to control such a road, but it is not to be supposed that Germany has any idea of annexing Asia Minor, although the resentment of Russia, in 1903, when she learned that Germany had received the Bagdad concession, may have been based on such a suspicion, and one writer says, "Russian susceptibilities ought to be regarded if European peace is to be maintained. The possession of a Turkish railway by Germany alone, a railway which Russia regards as Germany's first step toward acquiring Asia Minor, would be a standing cause of irritation between the two Powers."

Mr. Lovat Frazer contends that its completion will materially

affect English predominant interests in the Persian Gulf. He thinks that in order to preserve this, the section from the Gulf to Bagdad should be under British control, and says, "no ulterior motives are at present discernible in Germany's desire that England should become her partner in the Bagdad Railway.

Reinsch says, "The countries of Asia Minor, Syria and Mesopotamia have recently come into prominence as of great importance for colonization. We are accustomed to think of this region as composed of vast plains or of mountainous and barren tracts over which nomadic horsemen roam, and which are studded here and there with the ruins of cities of former empires. Few have thought of the industrial possibilities of this vast region; and yet there can be little doubt that after the next few decades it will become a great industrial and commercial center. Though not so immensely rich as China, its resources are abundant and accessible, while its population is sparse. Moreover, European colonists could settle here without being subjected to the inconvenience or dangers of a tropical climate, and without being obliged to modify greatly the habits of their homes. They could without much change transfer their trade and manufactures, and here continue their industrial activities. Of all the regions still available for European colonization, this is by far the most promising."

In the Bagdad Railway England sees a direct menace to the preservation and security of her trade in the regions covered by the road, but she recognizes that if the eastern terminus is Koweit, the *status quo* of the Persian Gulf is threatened, and that would not be tolerated as "an essential feature to the stability of English rule in India." In March, 1911, Mr. Balfour asked what course the government had taken in regard to the proposed branch line from Bagdad to Khanikin, and the continuation of the Bagdad line to the southward; that the question was one of commercial, political and strategical importance to Great Britain.

While the Germans are toiling with the great railroad problem of piercing the Taurus range, and spanning the desolate plains and swampy marshes of Babylonia, the British are planning a military road from Port Said direct to Koweit, and thence across Southern Persia to India. This is what is known as the "All-Red" Line; it has been surveyed, and the project will doubtless

soon pass out of the stage of discussion into something more real and tangible.

But my purpose is with the German road and its consequences. What a writer in the *Contemporary Review* (J. S. Mann) said several years ago in regard to German expansion generally applies equally to her purposes in Asia Minor and Turkey.

> Of course in all this there is no avowed expectation of a German transmarine empire; indeed such hopes are sometimes formally disavowed by the Pan-Germans themselves. The avowed hope is to build up political communities over-sea which shall be German in manners, thoughts and speech, demanding goods of German manufacture, supplying the German empire with raw material and strengthening the bond by taking the overflow of its population to increase and multiply under more favorable conditions than at home.

It has been indicated above how the United States may be affected, but to what extent cannot be foretold now. It may be safely stated, however, that the tide, now checked, of German emigration will in the near future set unimpeded toward the temperate and salubrious climate of the Middle East, and that these regions will be redeemed by German industry and German trade. Already the price of land is increasing, and it is predicted that the fertility of the Euphrates Valley will rival that of the Nile; capitalists are beginning to look along the line of the Bagdad Railroad for investments, and present prospects point to great opportunities in the near future.

I have described the Bagdad Railway itself at some length—and yet incompletely—not only because it is a remarkable example of human endeavor, but for the surpassing interest of its traject across the most ancient civilizations of the world; by the plains of Shinar and Chaldea and through the very site of the Garden of Eden, connecting, as by a wire, our own times with the dawn of history. But of course its premier importance is its influence and its effect upon commercial and economical conditions of Asia Minor, for under the control of Germans it represents the latest and most promising attempt of Germany to find a world-market which she has hitherto sought in South America, South and East Africa, and China. Asia Minor seems to meet all the requirements of German needs.

In the first place her people who emigrate there will retain their allegiance to the Fatherland, because amalgamation with an alien race and creed is not probable, and, secondly, with the con-

struction and operation of the railroad will follow, as pointed out above, the working of mines and quarries, and the clearing of immense forests celebrated for their scented woods, and the cultivation of those vast tracts and desolate wastes which only await the upturning of the soil to bring forth in abundance its natural yield of grain, tobacco, nuts, galls and dates. In these regions Germany will find a débouché for her products and manufactures, and practically without a rival, because railroad control means in effect political control, and it is the most important of all industrial undertakings in gaining and maintaining commercial predominence in the exploitation of a new country. These facts are fully recognized, and, so far as Russia is concerned, the Potsdam convention has eliminated the possibilities of a collision with her. With England, however, it is different. The branch road to Khanikin will be a severe blow to British trade with Persia, and unless British finance controls the Bagdad-Busra section, English merchants will probably lose the river traffic which they now control as that will not be able to withstand railway competition. It is thought by some writers that a large proportion of the passenger traffic through the Suez Canal, which in 1910 amounted to 220,000, will be diverted to the land route, but it does not seem likely that the mails between England and India will be taken from the steamers, although the time by rail between London and Bombay will be from four to seven days shorter than the sea route. It is as a freight carrier that the road will revolutionize the regions through which it passes.

So far as this country is concerned, any irritation that may be caused by conflicting commercial interests, especially if preferential rates are granted to German commerce, would probably be referred to the Hague tribunal.

It is worth noting that the founding of the present German navy happened to be practically coincident with the Bagdad concessions. This was in accord with the well established principle that commerce and colonies require an adequate fleet for protection and to maintain communications. No fleet, then no commerce, no new colonies. Napoleon's dream of an Eastern Empire vanished in the smoke of the Battle of the Nile.

The new conditions arising from the establishment of this road cannot fail to influence the political relations of Germany, Russia, England and Turkey, and, if to the extent of changing the dis-

position of their armed forces, then are we also deeply concerned. For such a situation, which will concentrate European endeavors in the middle East, will release us from certain obligations now deemed necessary to our naval strategy, thus granting to our fleet greater radius of action. Furthermore, it will render all the more imperative our naval policy to maintain a fleet sufficient always to hold our own in whichever one of the seven seas it may be called upon to protect the interests of the nation.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THEORY AND OPERATION OF THE GYROSCOPE AND THE SPERRY GYROSCOPIC COMPASS.[1]

By Ensign R. E. Gillmor, U. S. Navy.

Note.—A short article in the Proceedings of the Naval Institute of September, 1911, by Lieut.-Commander Dinger, gave a general description of the Sperry Gyroscopic Compass. Inasmuch as this instrument has now become an important part of the navigational equipment of our most modern battleships, it is thought that accurate knowledge of its principles, and instructions for its care and operation, should be placed before the service.

Historical.

In the present day of the steel ship and submarine, on which the magnetic compass cannot be considered an accurate and dependable instrument, the development of the gyroscopic compass to its present practical stage represents as important an advance in navigational science as the step the ancients made hundreds of years ago when they discovered the property of the magnetic needle and applied it to directing their ships instead of depending upon observations of the sun, moon and stars. Especially in submarines, and to a certain extent in battleships, with their movable masses of magnetic material, the use of the magnetic compass is becoming almost as much of an approximation as were the observations of celestial bodies the ancients used before the introduction of the magnetic needle.

As an indication of the rapid strides the present generation is making in science, it is interesting to compare the time taken to develop the magnetic compass to the time in which the gyroscopic compass has been developed. The original discovery of the properties of the magnetic needle is variously ascribed to the Chinese, Arabs, Greeks, Etruscans, Finns and Italians; Chinese historians claim the existence of an authentic record, showing that the prop-

[1] A lecture delivered before the midshipmen of the class of 1912 and the officers of the Naval Academy.

erties of the magnetic needle were known in China 2634 years B. C., but there is little definite proof that these properties were applied to nautical use until the beginning of the thirteenth century. Supposing the first intelligent and general application of the magnetic needle to have been about 1300, it required approximately 600 years to develop the compensated magnetic compass. Even the principles of the gyroscope, on which the gyroscopic compass depends, were not deduced until about 1851, so that from that time to the finished and accurate compass a period of only 60 years has elapsed; actually, only about eight of these years have been taken up in the real development of the compass.

THEORY.

The French scientist Foucault was the first to analyze the phenomena of the gyroscope, and to deduce any laws covering its action. This he did in 1851, when he used the gyroscope for demonstrating the rotation of the earth. Inasmuch as there was no means at that time of driving the gyroscope continuously at high rates of speed, great practical difficulties were encountered, and it was chiefly due to his powers of deduction that Foucault was enabled to obtain his theories, which were far beyond the points reached experimentally.

Before stating these laws, which were originally deduced by Foucault, such general terms as "degrees of freedom" and "precession" will be defined. "Degrees of freedom" refers to the manner in which the gyro is suspended; "three degrees of freedom" means suspension allowing freedom of motion about all three axes. Fig. 1 shows a typical gyroscope with three degrees of freedom, *i. e.*, freedom about the axis of rotation *B*, freedom about the axis *EE* and freedom about the axis *GG*. If the band *J* be securely clamped about the wheel *I*, attached to the ring *C*, freedom about the axis *EE* would be suppressed and the gyro would then be said to have a suspension with "two degrees of freedom." The term "gyroscope" is generally taken to mean a rotating mass suspended with "three degrees of freedom" and the term "gyrostat" is generally taken to mean a rotating mass suspended with "two degrees of freedom."

Suppose the clamp *J* in Fig. 1 is released and the wheel *A* is rotating rapidly with the side nearest the observer moving from right to left. If a force be impressed on the near side of ring *D*,

tending to push that side downward about the axis *GG*, this force will be resisted and movement of the gyro will take place about the axis *EE*, the top of ring *C* and axle *B* moving toward the left. Movement of the gyro is thus seen to take place at right angles to the impressed force. This movement normal to the impressed force is called "precession."

Throughout the study of any gyroscopic apparatus it must be remembered that movement of the gyroscope does not take place in the direction of the impressed force but that this tendency to move is transferred ninety degrees in the direction of rotation before it is manifested as motion.

FIG. 1.

Nothing but force caused by angular motion is resisted or causes precession; this angular motion may be about an axis within the gyro or remote from it, but must be angular motion. If linear motion be impressed, no gyroscopic reaction will result, even though the force so impressed be of large magnitude. As angular motion approaches linear motion, *i. e.*, as its radius of action is increased, the less will be its gyroscopic effect.

If the precessional ring *C*, Fig. 1, be clamped to the ring *D* so that precession is not allowed, then forces impressed on the ring *D* will not be resisted, even though they be due to angular motion, thus showing that precession must be allowed or the gyroscope will not have the property of resisting forces impressed upon it. It is for this reason that fly wheels and turbine wheels have no real

gyroscopic effect, precession being suppressed by the bearings in which the shaft is held.

Precession can be very easily and clearly explained by analyzing the actions of the rapidly rotating particles. A circle may be defined as a polygon of an infinite number of sides, and circular motion may be considered as motion about the sides of a polygon having an infinite number of sides. For purposes of analysis and illustration, we may reduce the number of sides to four, as shown in Fig. 2. We can disregard deviations from the straight path, as these deviations are equal and opposite on the sides of the square. Considering the infinite number of particles in the wheel passing

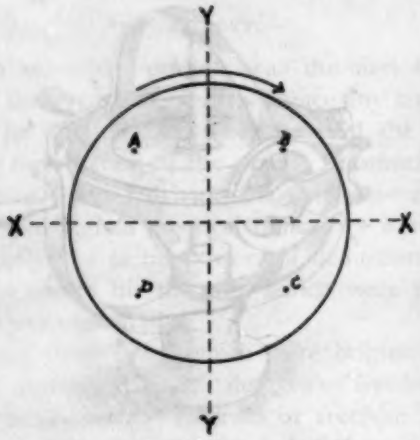

FIG. 2.

first from *A* to *B*, then from *B* to *C*, from *C* to *D*, and from *D* back to *A*, suppose a force is impressed on the end of the axis nearest the observer, tending to push it to the right, that is, tending to force the right-hand side of the wheel downward. In impressing this force there is a tendency to move the paths *BC* and *DA* parallel to themselves, and the particles in passing from *B* to *C*, and from *D* to *A*, have no tendency to be deflected from their original path. However, when these particles move from *A* to *B*, they find there is a force being impressed, tending to make them flow downward, and when passing from *C* to *D* they find a force tending to make them flow upward. Newton's first law of motion states that all matter resists being deflected from its path when once it has assumed a line of motion; the particles in the wheel

resist the tendency to make them flow downward when passing from *A* to *B*, and upward when passing from *C* to *D*, and in resisting they react upward on the upper side of the wheel, and downward on the lower side of the wheel, causing motion of the wheel about the axis *XX;* this motion is termed "precession." The motion of precession causes the particles flowing from *B* to *C* and from *D* to *A* to be deflected from their paths; they resist this deflection, and this resistance is manifested by a stress resisting the impressed force and exactly equal to it. It will be noted that the force impressed has been deflected 90° in the direction of rotation, transferred into motion, and by this motion deflected another 90° in the direction of rotation, where it is manifested in a stress

FIG. 3.

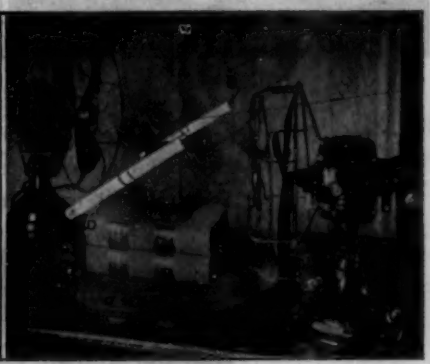

FIG. 4.

opposing the force originally impressed. No motion will take place about the axis *YY*, because if this motion should take place it would immediately remove its own cause. It will be seen from the above that resistance to impressed force is entirely due to precession, so that if precession is suppressed the impressed force will not be resisted.

The phenomena of precession can be very well illustrated by using the analogy of a rotating mass of air, set up by two fans, as shown in Fig. 3. If the air passing through the paper tubes be deflected by moving the left-hand side of the tubes downward, as shown in Fig. 4, these particles in passing through the tube will react, causing precession, as shown in Fig. 5. If the force is

impressed, as shown in Fig. 6, precession will result, as shown in Fig. 7.[1]

Foucault's first law states that any gyroscope possessing three degrees of freedom, that is, free to move in all three planes and

FIG. 5.

FIG. 6.

unaffected by the force of gravity (as it will be if the axis of rotation in the three planes coincide with each other and with the center of gravity), must indicate the rotation of the earth since

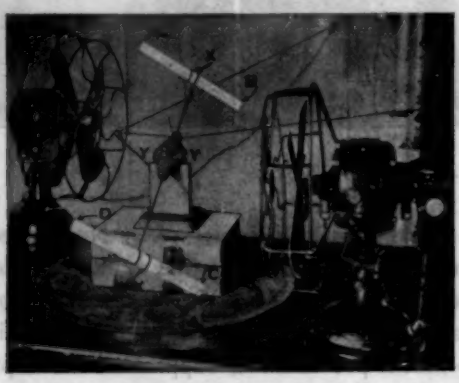

FIG. 7.

[1] An excellent and simple explanation of the causes of precession may be found on p. 150 (5th edition, 1904) of "Dynamics of Rotation," by A. M. Worthington, published by Longmans, Green & Co. This explanation of the starting of precession is devoid of mathematics, popular in character and quite satisfactory. Other references are "Spinning Tops and Gyroscopic Motion," by Harold Crabtree (Longmans, Green & Co.), and "The Gyro Compass," a description of the theory and use of the Auschütz Gyro Compass, published by Elliott Bros, London.

the gyro will continue with its plane of rotation fixed in space, while the earth turns around "under it." His second law states that any gyrostat free to move in two planes only, will, at any place on the earth's surface, other than the two poles, tend to set itself with its axis of rotation in the plane of the axis of the earth itself by reason of the relative rotation of the two bodies.

This second law is illustrated in Fig. 8. Suppose a gyro, suspended so that freedom about the horizontal axis is partly suppressed by gravity, this suspension being so devised that the force

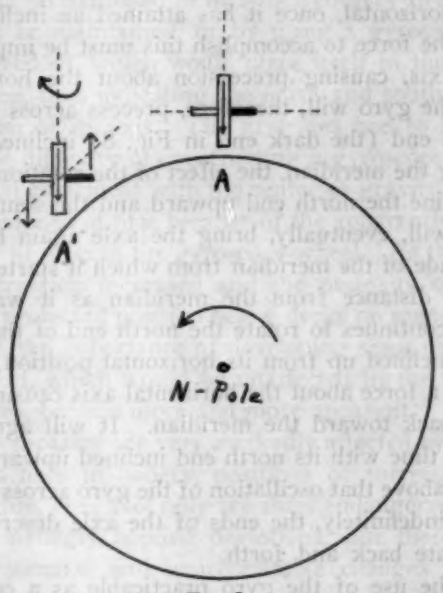

FIG. 8.

of gravity will always tend to place the axis in a horizontal position. Consider this gyro rotating at full speed with axis E and W on the earth's surface, as shown at A. Since the gyro will tend to maintain its plane of rotation in space, the earth in rotating will rotate "out from under" the gyro, leaving it suspended out of the vertical with one end of its axis inclined up from the horizontal, as shown at A', which is the position to which A moves in about 3 hours. The manner in which it is suspended will cause the force of gravity to impress forces on this gyroscope, tending to bring its axis to the horizontal. These forces will cause precession as indicated by the arrow at A'. As the gyro precesses the plane of its

rotation will become nearer and nearer coincident with that of the earth, and, consequently, the earth will have less and less tendency to rotate "out from under" it. Now if the axle if the gyro could be brought to a horizontal position when on the meridian it would persist in that position since its plane of rotation would be coincident with that of the earth and the earth would have no tendency to turn "out from under" it. However, where freedom of motion is suppressed about the horizontal axis only, as in Fig. 8, there exists no force which will bring the axle of the gyro to the horizontal, once it has attained an inclined position, inasmuch as the force to accomplish this must be impressed about the vertical axis, causing precession about the horizontal axis. The axle of the gyro will, therefore, precess across the meridian with its north end (the dark end in Fig. 8) inclined downward. After crossing the meridian, the effect of the rotation of the earth will be to incline the north end upward and the south end downward. This will, eventually, bring the axle again horizontal on the opposite side of the meridian from which it started, and at the same angular distance from the meridian as it was originally. As the earth continues to rotate the north end of the axle of the gyro will be inclined up from its horizontal position, gravity will again impress a force about the horizontal axis causing precession of the gyro back toward the meridian. It will again cross the meridian, this time with its north end inclined upward. It can be seen from the above that oscillation of the gyro across the meridian will continue indefinitely, the ends of the axle describing ellipses as they oscillate back and forth.

To make the use of the gyro practicable as a compass these oscillations across the meridian must be damped in such manner as to bring the gyro to a resting position with its plane of rotation coincident with that of the earth and with its axle horizontal. This is done by impressing a constantly decreasing force about the vertical axis to cause precession of gyro axle toward the horizontal as it approaches the meridian, the ends of the axle describing a spiral as they come to rest on the meridian. The manner in which this is done will be described later.

When the gyro is anywhere but on the equator, another difficulty is encountered, due to the fact that the earth's rotation has two components, one tangential to the surface of the earth, which, as already explained, tends to cause the gyro to precess

toward the north and south meridian, and one normal to the surface of the earth, which tends to leave the north end of the gyro on one side of the meridian.

PROBLEMS IN CONSTRUCTION.

The deduction of Foucault's laws immediately suggested the use of the gyroscope as a compass, either by using it with three degrees of freedom for establishing certain fixed lines in space with which bearings might be compared or by which courses already definitely known might be maintained, or by using a gyroscope with two degrees of freedom, which would place itself in the plane of the earth's rotation, thus indicating the north and south mechanically by the position of its axis. The first idea had to be abandoned because of the difficulty of constructing a gyroscope with its centers of rotation coincident with the center of gravity. The second idea was abandoned at first because of the apparently insurmountable difficulty of driving the gyroscope wheel. As the use of steel in ship construction increased and the necessity of placing the compass in a protected position below decks on men-of-war began to be realized, the importance of developing some device for indicating direction, which would be unaffected by the varying magnetic influences, became more and more apparent.

Magnetic compasses are very markedly affected by such varying conditions as fires in boilers, positions of turrets, cranes, and shock of gun fire, etc. Not only are ships endangered by reason of incorrect or wrongly applied deviations, but there are several instances of peculiar and unaccountable changes in variations, which, in at least one instance, have resulted in running a ship on the rocks. The *Carnegie*, a ship built for scientific research, is now engaged in a trip around the world, for the purpose of checking up and verifying variations as shown on Admiralty, Coast Survey and Hydrographic survey charts. Several errors have already been found and it is reasonable to believe that there are errors which will not be found and that variations will change from year to year, making navigation by the magnetic compass in the vicinity of rocks and islands somewhat hazardous. In view of these facts, as brought out by the development of steel ships and submarines, the investigations of the world's magnetic properties and the increasing need for placing the standard compass in some protected position, so that it can be used after an action,

several inventors have for the past six or eight years been endeavoring to apply the gyroscope for use as a compass.

The problems which confronted the inventors having as their starting point Foucault's second law, as explained before, may be stated as follows:

(1) To suspend the gyro with perfect freedom about the vertical axis so that it is free to precess toward the meridian.

(2) To damp the oscillations of the gyro across the meridian so that it will quickly settle down with its axis north and south.

(3) To constantly impress just exactly the right degree of force to keep it precessing to follow the component of the earth's rotation, which is normal to the earth's surface.

(4) To drive the gyro at a high rate of speed in order to furnish the directive force required.

When these first four problems were solved, the result would have been an instrument which would accurately indicate the north and south meridian, if such instrument could be used only in a fixed position on land. If the instrument were to be placed on a ship, several further problems remained to be solved. These were:

(5) To so suspend the gyro that forces of acceleration and deceleration introduced by movements of the ship will not cause it to oscillate off the meridian, making its readings incorrect. These forces of acceleration and deceleration introduced by the ship are:

(a) Acceleration and deceleration arising from starting and stopping the ship and changing its speed.

(b) Centrifugal forces introduced by the ship in turning.

(c) Forces due to non-coincidence of the center of the gyroscope with the center of oscillation of the ship, that is, forces introduced by rolling and pitching of the ship.

(6) To correct the compass for the deflection, due to northerly and southerly components of the ship's movement, which, of course, act on the compass just as the movement due to the earth's rotation, except, of course, in a very much less degree.

Mr. Edison says that when in the development of machines and apparatus you find yourself proceeding toward greater and greater complexity, you can be almost certain that your efforts are along the wrong line, and that you will not be very successful, but that when you find your developments tending toward greater and greater simplicity, you can be sure that you are proceeding along

correct lines, and that your efforts will most probably be successful.

In the development of the gyroscopic compass this has been especially true. At first the development led to much complication, but the apparatus finally evolved is extremely simple and easily understood.

Fig. 9 is a diagrammatic section of the compass. The gyro wheel itself is mounted with its shaft in ball bearings in the vacuum casing, indicated at *B*, in Fig. 9. This casing is carried in trunnions in the ring *D* called the vertical cardian ring. This

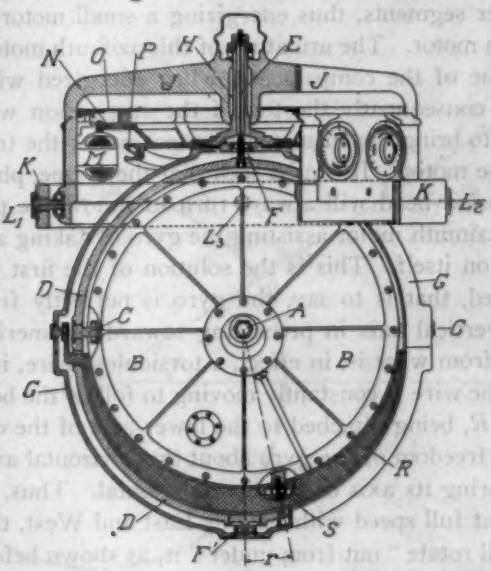

FIG. 9.

ring is suspended in the frame *H* by the suspension wire *E*, the top of which is held in the frame and the bottom of which is made fast to the vertical cardian ring. Attached to the frame and integral with it is a ring *G*, which surrounds the vertical cardian ring; this is termed the "phantom ring," because it is made to follow all tendencies of the vertical cardian ring to move about the vertical axis. Swung in trunnions in the phantom ring and passing through the vertical cardian ring, but not touching it, is the bail *R*, which is attached to the gyro casing at the point marked *S*. The vertical cardian ring is of such shape at the bottom as to permit the bail to swing freely through it. Attached to the ver-

tical cardian ring, and projecting through, but not touching the phantom ring, are two posts, not shown in Fig. 9. On these posts are carried small silver wheels, which rest on a flat commutator, which is carried on the movable frame of the compass, of which the phantom ring and suspension head are integral parts. This commutator has two silver segments, insulated from each other by a narrow piece of hard rubber. Normally, the silver trolley wheel attached to the vertical cardian ring rests on this insulating strip. If the gyro tends to move about the vertical axis, this trolley is moved off of the insulating segment and on to one of the silver segments, thus energizing a small motor *M*, termed the azimuth motor. The armature of this azimuth motor is geared to the frame of the compass and when energized will turn this frame and consequently the top of the suspension wire in such manner as to bring the insulated segment under the trolley wheel and stop the motor. It can be seen that the frame, phantom ring and suspension head will always turn to follow the gyro in azimuth, the azimuth motor assisting the gyro by taking all the work of turning on itself. This is the solution of the first problem, as before stated, that is to say, the gyro is perfectly free to move about the vertical axis in precessing toward the meridian, being suspended from what is, in effect, a torsionless wire, inasmuch as the top of the wire is constantly moving to follow the bottom.

The bail *R*, being attached to the lower side of the casing, suppresses the freedom of the gyro about the horizontal axis, tending always to bring its axis of rotation horizontal. Thus, if the gyro is rotating at full speed with its axis East and West, the earth, in turning, will rotate " out from under " it, as shown before, leaving its axis suspended out of the horizontal. The bail will exert a force through the point of attachment *S*, tending to bring the axis to the horizontal and in so doing will cause the axis of the gyro to precess toward the meridian.

It will be noticed that the bail is attached to the casing eccentrically, so that when the axis of the gyro is out of the horizontal the bail acts not only about the horizontal axis, but also about the vertical axis. This force impressed about the vertical axis opposes the oscillation of the gyro by precessing its axle toward a horizontal position, thus damping the precession about the vertical axis as it approaches the meridian. The amount of this damping constantly decreases as the axle of the gyro approaches the meridian,

and comes nearer and nearer to the horizontal, until, when the axle of the gyro is on the meridian and horizontal, the weight of the bail ceases to act about either axis the weight being then entirely supported by the trunnions in the phantom ring. When on the meridian with axle horizontal the gyro may be said to be suspended with three degrees of freedom and is statically balanced about all axes. In effect, the action of the bail is exactly as if you damped the swing of a pendulum with your hand and constantly lessened the amount of restraining force as the pendulum approached the vertical. This is the solution of the second problem, as before

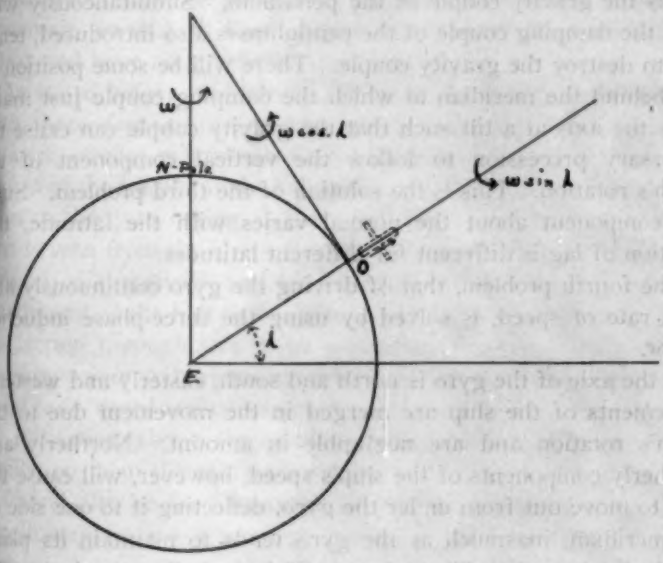

FIG. 10.

stated, that is to say, the oscillations of the gyro across the meridian are damped so that it will quickly settle down with its axis north and south.

Fig. 10 shows that the angular velocity of the earth at any point O can be resolved into two components, $\omega \cos \lambda$, about a tangent to the surface of the earth at the point O and $\omega \sin \lambda$ about the normal to the surface of the earth at that point; λ being the latitude of point O. If the plane of rotation of the gyro is not coincident with the plane of rotation of the earth's tangential component, the earth moves "out from under" the gyro, leaving its axis suspended out of the horizontal. The component of the earth's rota-

tion about the normal to its surface leaves the north end of the axis behind on the east side of the meridian, inasmuch as the gyro tends to maintain its plane of rotation in space.

Considering the gyro *with its axis on the meridian*, and analyzing the effects of the vertical component of the earth's rotation, we see that the earth, in turning from west to east under the compass, which tends to maintain its direction in space, will leave the north end of the axis behind on the east side of the meridian. The moment the axis is left behind the meridian, a portion of the tangential component of the earth's rotation causes a tilt, which introduces the gravity couple of the pendulum. Simultaneously with this, the damping couple of the pendulum is also introduced, tending to destroy the gravity couple. There will be some position of lag behind the meridian at which the damping couple just maintains the axis at a tilt such that the gravity couple can cause the necessary precession to follow the vertical component of the earth's rotation. This is the solution of the third problem. Since the component about the normal varies with the latitude, this position of lag is different for different latitudes.

The fourth problem, that of driving the gyro continuously at a high rate of speed, is solved by using the three-phase induction motor.

If the axle of the gyro is north and south, easterly and westerly movements of the ship are merged in the movement due to the earth's rotation and are negligible in amount. Northerly and southerly components of the ship's speed, however, will cause the ship to move out from under the gyro, deflecting it to one side of the meridian, inasmuch as the gyro tends to maintain its plane of rotation in space. The point at which the bail is attached to the gyro casing is very accurately determined, so that in accelerating and decelerating the ship in starting and stopping, or changing speed, the inertia of the bail acting about the horizontal axis will impress just the right amount of force to orient the gyro to the proper position on one side of the meridian to fulfill the new condition of speed and its damping couple will prevent any oscillation.

Only the northerly or southerly components of the centrifugal forces introduced by the ship in turning need be considered and these forces are exactly comparable to the northerly or southerly components of ship's speed. That is, if the ship, steaming due east, were to swing about a quadrant to a course due north, the effect

of oscillation would be equal to that of the ship starting from rest and attaining speed all on a northerly course. All are, therefore, cases of the same acceleration and are compensated for by the ballistic properties of the bail.

Exact compensation for acceleration of the ship is only obtained theoretically at one given latitude, but the amount of oscillation produced at other latitudes is comparatively slight in all cases, and disappears entirely within a short interval after the ship comes upon a steady course.

Forces introduced by rolling and pitching of the ship are eliminated by mounting the compass in ordinary gimbal rings or cardian mounting, so that all these forces which reach the compass are linear and have no gyroscopic reaction.

As stated before, the gyro is, when on the meridian, suspended with three degrees of freedom and is statically balanced about all axes, so that extraneous forces have no effect on it except by reason of the inertia of the bail acting through the point of attachment to the gyro casing.

It is seen from the above that the fifth problem is solved by the method of suspension and by accurately calculating the point of attachment of the bail to the gyro casing so that the inertia of the bail acting through this point will orient the gyro to its correct resting position to harmonize with the attained speed condition due to latitude, speed and course of the ship, and at the same time will, by its action about the vertical axis, effectually prevent any oscillation from the correct resting position.

It will also be seen from the above that the axis of the gyroscopic compass on a moving ship does not point exactly north because:

(1) It must lag a certain distance behind the meridian in order to introduce the necessary tilt for following the vertical component of the earth's rotation, the amount of this lag depending upon the latitude.

(2) The northerly or southerly component of the ship's speed causes a certain deflection from the meridian. This deflection is, for a given latitude and speed, proportional to the cosine of the angle between the ship's course and north.

In the Sperry gyroscopic compass a mechanical device is used, which, when set approximately for latitude and speed of the ship, will automatically apply all corrections to the lubbers' point, mak-

ing the readings of the compass card referred to the lubbers' point absolutely true. This device will also, at all times, show the amount of the correction that is being applied. It consists of an

FIG. 11.

arrangement of cams, as shown in Figs. 19 and 20. This is the solution of the sixth problem.

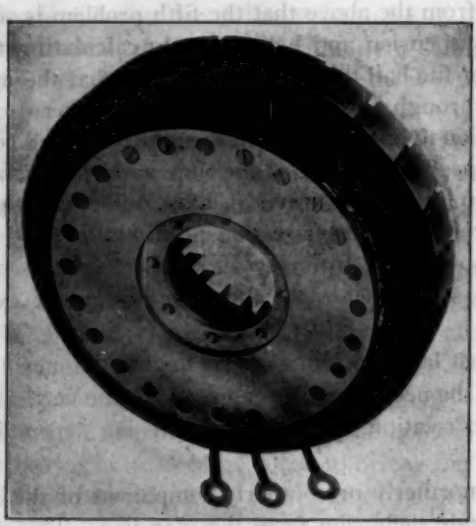

FIG. 12.

DESCRIPTION OF COMPASS AND ACCESSORIES.

The gyro is driven by a three-phase induction motor the stator of which is mounted on the side of the gyro casing and projects inside of the gyro wheel, and the internal periphery of which carries the short-circuited bars of the squirrel-cage induction motor.

The gyro wheel is shown in Fig. 11, which also shows the short-circuited bars and the ball bearings.

Fig. 12 shows the stator of the motor, which is fixed to the side of the casing. This motor is capable of driving the gyro at 10,000 r. p. m.; the normal speed is about 8600.

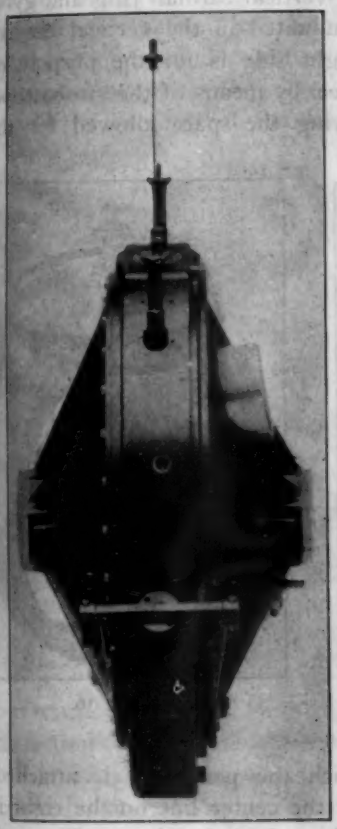

FIG. 13.

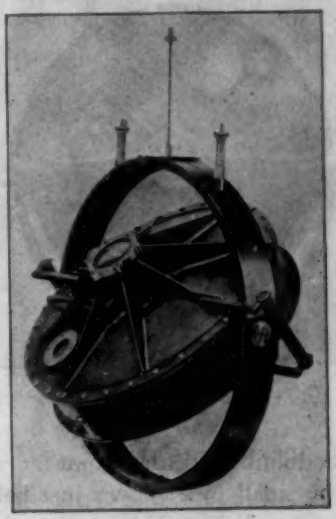

FIG. 14.

Fig. 13 is a side view of the vertical cardian ring, gyro casing and suspension wire. This shows the two posts on which are carried the silver trolley wheels. Levels are provided as shown. Since the axle of the gyro is always inclined out of the horizontal when it is off the meridian and precessing toward it, the position of the bubbles in the levels will tell whether or not the compass readings are to be depended upon. In starting the compass off the meridian, if it is seen by the position of the bubble in the

level that it is not on the meridian, it may be oriented by hand by impressing a force on the upper end of the axis. The manner in which this is done will be described in detail later under Installation, Care and Operation. Just below the level will be seen the hole through which one of the pendulum arms passes.

Fig. 14 is another view of the vertical cardian ring and gyro. This shows how the casing is mounted in the vertical cardian ring. The window on lower right side is for the purpose of getting the speed of the gyro wheel by means of the stroboscope.

Fig. 15 is another view showing the space allowed for the

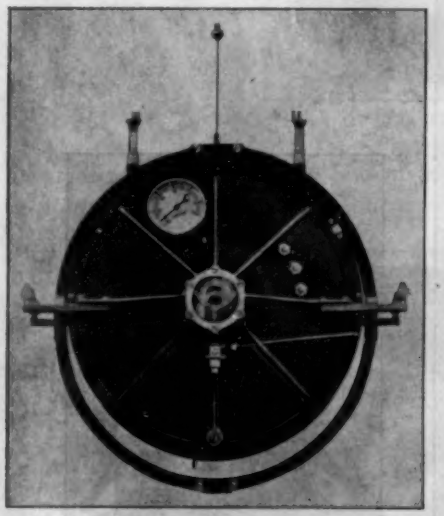

FIG. 15.

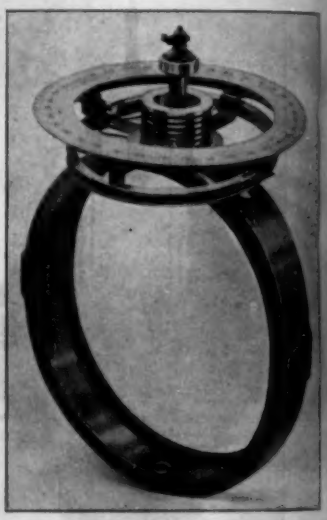

FIG. 16.

pendulum and the point at which the pendulum is attached. The small pipe shown just below the center line on the right is for equalizing the amount of oil on both bearings. The condition of oil and bearings can be seen through the windows on the ends of the journals. The gage at the top shows the degree of vacuum on the casing. The casing is kept under vacuum so that less power is required in driving gyro, there is less heating, and the bearings are kept in better condition. With the new compass no loss of vacuum has occurred for several months. The pendulum is swung in the space shown between casing and vertical cardian ring, its arms go through the vertical cardian ring

without touching it, and are secured in trunnions in the phantom ring which is shown in Fig. 16.

At the top of the structure on the phantom ring is seen the suspension head. Through the slip rings shown just below the suspension head, current is conveyed to the moving system for driving the gyro and for energizing the azimuth motor. The inclined ring shown just below the compass card is the cam which, acting in combination with cams set for latitude and speed, automatically applies the corrections to the lubbers' point, according to the heading of the ship. If heading east or west, no

FIG. 17.

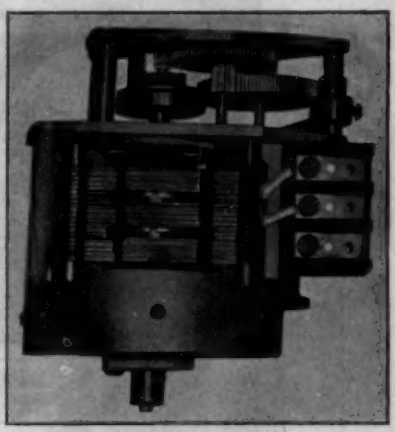

FIG. 18.

correction is applied. If heading north or south, the maximum correction for the particular speed and latitude is applied.

Fig. 18 is a view of the small reversible motor called the azimuth motor. The armature of this motor is slightly offset from its field so that when it is not energized the armature drops and disconnects itself mechanically, by means of the clutch shown, from the gearing driving the compass frame. The motor is driven by direct current of 20 volts. It will be replaced in later compasses by a three-phase A. C. motor for the reason that the problem of reversal is simpler with the A. C. motor, and brushes will be eliminated thus making the clutch unnecessary, as without brushes the motor will not act as a drag on the moving system.

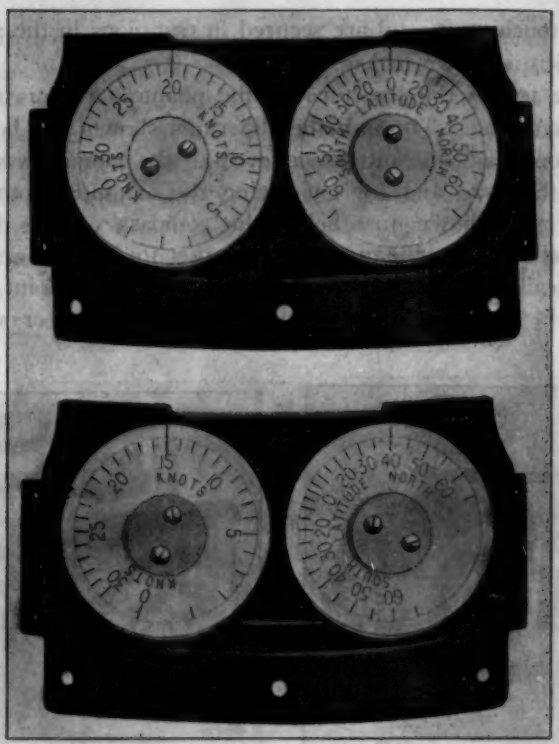

FIG. 19.

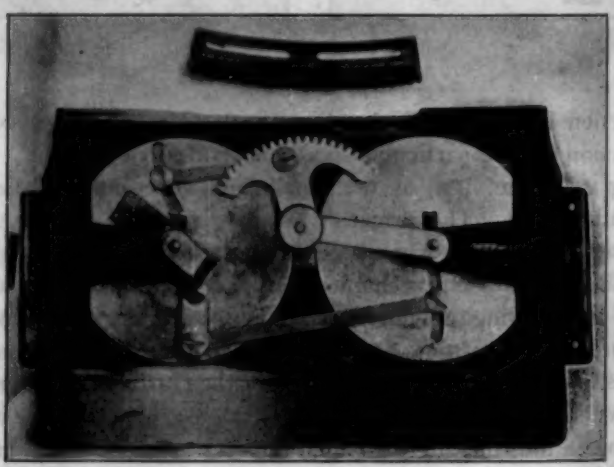

FIG. 20.

Fig. 19 shows the front view of the automatic correction device.

Fig. 20 is a back view of this device showing the cams which, when connected to the cosine cam under the compass card, automatically solve the equations of speed and latitude.

Fig. 21 is a top view of the compass showing a correction of a little over six degrees applied to lubbers' point. This also shows method of suspension in gimbal rings. On the upper and lower sides of the inner circle can be seen the silver segments carried on the phantom ring and with which the trolley wheel attached to

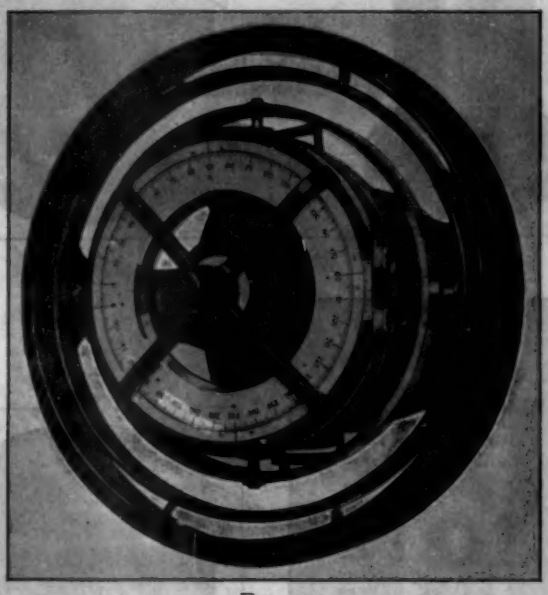

FIG. 21.

the vertical cardian ring makes contact in order to drive the frame of the compass to follow the sensitive or gyroscopic element.

Fig. 23 shows the compass assembled with casing removed.

Fig. 24 shows compass with casing on, cover removed.

Fig. 25 shows it completely covered by its casing. It can be locked in this condition to prevent tampering.

The apparatus which has just been described is called the master compass. Its position in the ship should be below the protective deck, behind the heaviest armor of the ship and as near the metacentric line of the ship as possible. This location would of

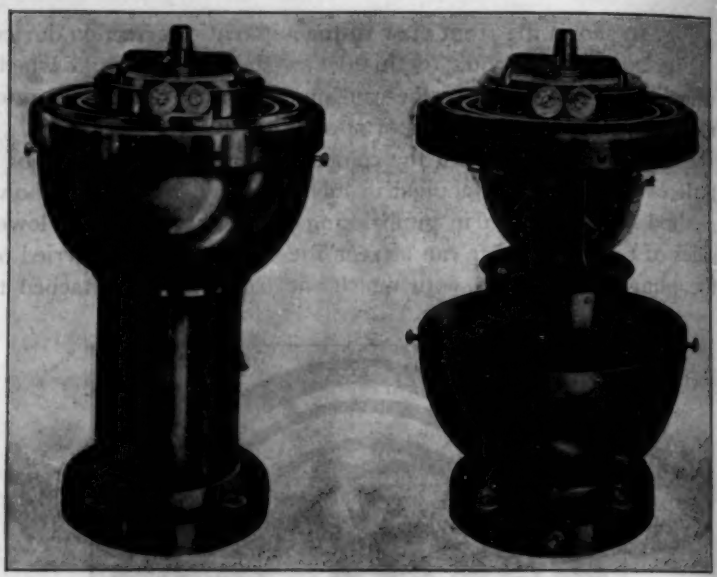

FIG. 24. FIG. 23.

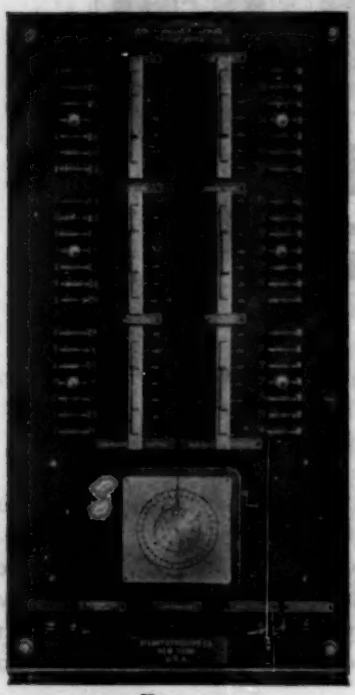

FIG. 22.

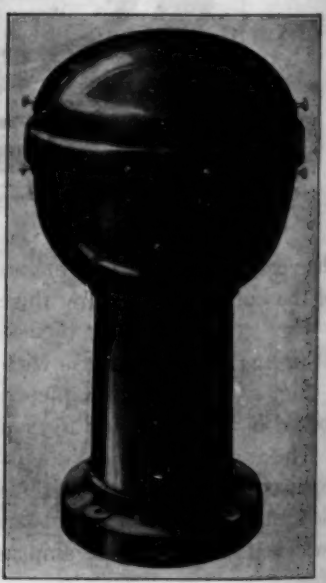

FIG. 25.

course remove it from the view of the helmsman and navigator. For the purpose of indicating, to distant stations, the heading of the ship, as shown on the master compass, an auxiliary system is used, called the compass repeater system. These repeaters are placed on the bridge, in the conning tower, in the steering engine room, in the chart house, in the captain's cabin, and wherever else desired. They have a dial similar to the ordinary compass dial controlled electrically by the movements of the master compass, so that the repeaters at all times indicate the same readings as the master compass. This distant control of repeater dials from master compass dials is accomplished by a commutator geared to the moving frame of the master compass, and controlling the flow of current to the poles of a small six-pole motor in the repeaters, a diagram of which is shown in Fig. 26. The armature of this motor is geared to the

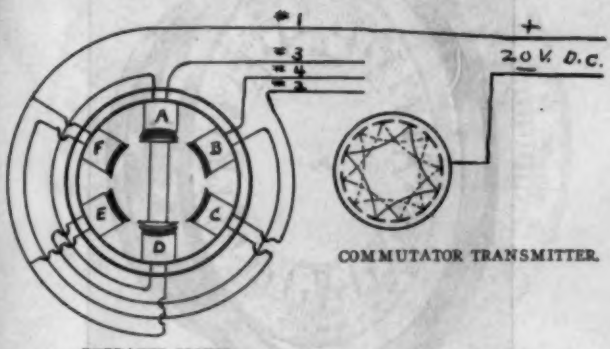

FIG. 26.

repeater dial so that one complete revolution of this armature turns the dials through two degrees. The brushes of the controlling commutator are geared to the master compass dial so that they make one complete revolution with two degrees movement of the compass. Four wires connect the segments of the commutator to the motor; one of these wires is common to all poles, the other three each go to one of the pairs of poles, as shown in Fig. 26. Suppose the brush of the master compass commutator to be turned into such position as to supply current over wire 1 returning it by wire 3, then poles *A* and *D* would be energized and the armature would be drawn into the position shown by the sketch. Now suppose that the brush is turned so as to connect wires 3 and 4 to the negative source of supply as will be the case

if the master compass moves ⅙°, then the armature is drawn half way between poles *A* and *B*, and poles *E* and *D*, or it has moved through 1/12 of a revolution, and the dial through ⅙ of a degree. Since the move takes place half way in the sixth of a degree movement of the master compass, the maximum error of the repeaters is 1/12 of a degree or 5′. These repeaters are portable and may be placed in any position; they are made in two types at present, the binnacle type, which is mounted in gimbal rings, and the wall type, which may be fixed to the wall. Another type is being developed, called the recording type, which is so designed with

FIG. 27.

clock-work attachment as to keep a complete record of all courses steered. This will be of considerable value to the navigator, both for checking up courses used in dead reckoning and for checking the work of the helmsman and officer of the deck.

Fig. 27 is a view of the wall type of repeater, such as is used in conning tower, captain's cabin, etc.

Fig. 28 is a view of the new card which it is proposed to use on repeaters. It will be noticed that the degrees are marked in heavy characters on the outside of the circle. A design for a repeater having an integrating dial in the center has been proposed and will probably be tried in the near future. The center or integrating

dial will be so geared to the outer dial as to make one complete revolution for each ten degrees movement of the outer dial. The inner dial will be graduated by degrees and 1/12 degrees so that the heading can be determined and the course steered very accurately. The transmitting commutator is so mounted on the master compass that corrections which are applied to the lubbers' point by the automatic correcting device are also applied to all repeaters.

All wires to repeaters pass through cut-out switches on the switchboard shown in Fig. 22. Each wire is fused so that in

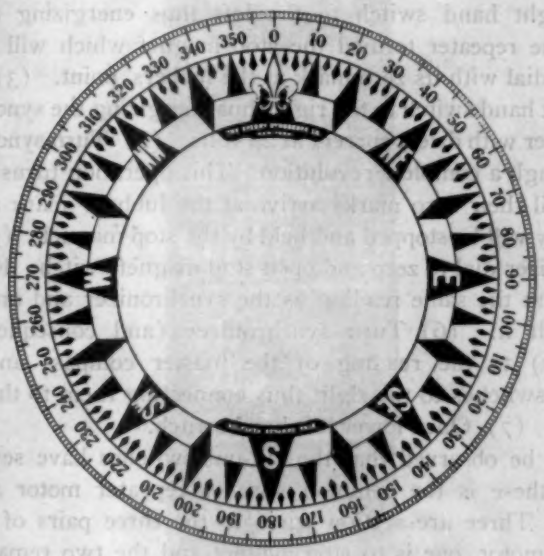

FIG. 28.

case of short circuit on any repeater its fuses will blow, thus isolating it so that its troubles will not affect the other repeaters. In the common wire to each repeater is a small incandescent lamp which can be seen in the center of the switches. When repeaters are in operation and current is flowing to their motors these lamps are lighted. If anything should occur to open a repeater circuit this state of affairs would be indicated at the switchboard by the lamp for that repeater failing to glow.

It will be noticed that the cut-out switches are all double-throw; this permits of connecting any repeater to the master compass or to a device termed the synchronizer (shown at bottom of board)

with which the repeaters may be turned by hand to any desired reading. The synchronizer is used to bring the repeaters to the same reading and to the reading of the master compass.

To synchronize: (1) Throw switch of the repeater or repeaters to be synchronized to the left thus disconnecting them from the master compass transmitter and connecting them to a similar transmitter within the synchronizer. This operation also turns out small lamps which illuminate the repeater dials and which, when lighted, indicate to the helmsman or other person using the repeater, that it is connected to the master compass. (2) Throw lower right hand switch to the left thus energizing a device within the repeater termed the stop magnet which will stop the repeater dial with its zero mark at the lubbers' point. (3) Throw lower left hand switch to the right thus energizing the synchronizer transmitter with direct current at 20 volts. (4) Turn synchronizer dial through a complete revolution. This operation turns repeater dials until their zero marks arrive at the lubbers' mark at which point they will be stopped and held by the stop magnet. (5) Turn synchronizer dial to zero and open stop magnet switch. Repeaters are now at the same reading as the synchronizer and are free to turn with it. (6) Turn synchronizer (and consequently the repeaters) to the reading of the master compass and throw repeater switches to the right thus connecting them to the master compass. (7) Open lower left hand switch.

It will be observed that the cut-out switches have seven legs. One of these is the common wire to repeater motor and stop magnet. Three are section wires to the three pairs of poles in repeater motor, one is to stop magnet and the two remaining go to the binnacle lamp.

The switchboard in Fig. 29 supplies 125 volts D. C. for driving the motor generator, and supplies the three-phase A. C. from this motor generator to the induction motor of the compass. This switchboard also supplies 20 volts direct current to the repeater system and the azimuth motor of the compass. The instruments at the top of the board are A. C. ammeter and voltmeter for showing the current being applied to the gyro motor and the voltage at which it is being supplied. The voltmeter is provided with a switch shown between the two instruments by means of which the voltage of any of the three phases may be determined. The three lamps at the top of the board are in series with each

phase wire and indicate by their glow when the three phases are all in operation. The starting and speed control box for motor generator is shown at bottom of switchboard. The repeaters are provided with two means of 20 volt supply, one from motor generator and one from storage battery. The solenoid operated switch, shown just above starting box, is used for automatically disconnecting the generator in case of failure of its voltage so that battery may remain connected and not discharge back through generator.

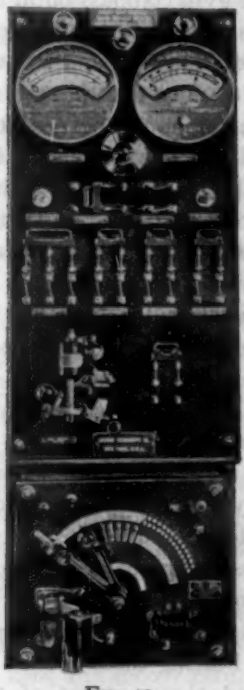

FIG. 29.

A reversing switch is provided with which two of the phase wires to the gyro motor may be reversed, thus reversing the motor to assist in stopping gyro when shutting down the compass. Another switch is provided for short circuiting the phase indicating lamps in case any of them burn out. The shorter arm on the starting box is used for energizing the motor field. The longer arm is for the purpose of controlling motor-armature resistance and motor field resistance; *i. e.*, for starting the motor and controlling its speed.

The usual no load and overload releases are provided which reset starting arms when circuit supplying motor generator is opened or overloaded.

Fig. 17 is a view of the motor generator. It has a capacity at the generator end of ¼ K. W. with unity power factor and is about 10 inches high and 14 inches long.

INSTALLATION.

When installing the gyro compass outfit the master compass and the two switchboards should be placed together below the protective deck behind heavy armor, and as near the metacentric line of the ship as possible. The central station on board battleships has usually been found to be the best location.

The navy standard practice should be followed as to conduit, cable and connection boxes in putting in the wiring for repeaters.

The installation should be placed under the care of a good electrician who is not a watch stander and who can give most of his time to keeping the outfit in good condition. One of the electricians in the fire control division will be found to be a good man for this. On the *Delaware* the electrician who cared for the compass also looked out for the condition of the ship's service and fire control telephones, but as he was an exceptionally good man, he had no difficulty in doing both.

The switchboards and motor generator should be given the ordinary care usually given such electrical appliances, that is, they should be kept clean, binding posts tightened, etc.

The master compass and repeaters should be kept clean and free from dust. Master compass casings should be kept on at all times except when adjusting, starting or making observations of compass. Level of oil in bearing cases should be frequently noted—it should never be filled above center of the glass and may be allowed to fall quite low before refilling. A special oil which is furnished with the compass should be used.

STARTING (preliminary adjustment).

Before starting it is well to remove the silver trolley wheels and examine contacts carefully. Replace trolleys with a small piece of paper inserted in trolley arm in such manner as to hold it out of physical contact with silver segments—note position of sensitive element—it should be in an exact central position and

when moved away from that position should return to it by oscillations with period of from 10 to 20 seconds. If sensitive element does not return to a central position relative to frame, or phantom ring, the head of suspension wire should be shifted until it does. This is done by means of a tangential screw found under the cap over the suspension head. Note positions of bubbles in levels—levels should be adjusted so that when compass is at rest the bubbles are at the southerly end—when running in 40 N. Lat. the bubbles will be in the center. All compasses are adjusted to run with level in 40 N. Lat.

The levels should never require adjustment. If on examination they are found to be out of adjustment, one should look carefully over the gyro casing to see if any weights have been shifted or heavy objects allowed to accumulate thereon. Remove paper from trolleys and test azimuth motor with D. C. power on. Motor should respond freely in either direction and should not cause an oscillating motion of frame when gyro is brought to rest.

To Start (see Fig. 29).

(1) See that all switches on gyro energy board are open—starting arms back. Tell distribution room to throw power on gyro system.

(2) Throw power on azimuth motor.

(3) Throw power on motor generator.

(4) Connect gyro motor to motor generator being careful to see that double-throw switch is thrown into position marked running and not position marked stopping.

(5) Both starting arm and generator field control arm being thrown to left, the motor armature circuit is open and all resistance is cut out of generator field and motor field.

(6) Throw the shorter arm all the way over to the right, thus energizing the motor field. Move the longer arm to the right, thus gradually accelerating the motor-generator until the A. C. ammeter shows a current of three amperes flowing to the gyro motor. Voltage will then be about 40. As gyro gradually accelerates, current will drop and voltage will rise. As current tends to drop keep it at 3 amperes by moving starting arm to the right cutting out more and more armature resistance until gyro is nearly up to full speed, as will be shown by voltage of about 120 with current of 3 amperes. Starting arm by this time will have cut out all armature resistance

and will be on speed regulating points to the right which weaken field of motor by cutting in field resistance, thus increasing the speed (shunt motor). Leave starting arm in this position and as gyro gradually accelerates up to full speed current will drop to one ampere and voltage will rise to 130 which is the proper criterion for correct speed.

In accelerating to full speed the gyro may pass through two critical stages at which the period of revolution is synchronous with the characteristic of the shaft thus causing vibration of the sensitive or gyroscopic element. It is well to steady the sensitive element with the hand in passing through these stages although no harm will result.

About twenty to twenty-five minutes are required to accelerate the gyro to full speed.

If, in starting the compass, there is any need to get correct readings immediately, the axis may be placed on the meridian by hand in the following manner: When the gyro is running at full speed bring its axis level by exerting a slight torque on the trolley posts in the direction in which it is desired to make the bubble go. After leveling the gyro watch the bubble and time its departure as it moves from the center of the level. The number of divisions on the level over which the bubble moves per minute, multiplied by five, gives approximately, the displacement in degrees between the axis of the gyro and the north and south meridian. The direction of north is shown by the direction in which the bubble moves. The compass may be set approximately, in accordance with the displacement ascertained from the action of the bubble, by applying moderate vertical presure on the end of the axis which is highest. Pressure on the north end of the axis causes westerly movement and vice versa, but it is only necessary to remember to exert a force on the highest end tending to force it to a normal position and in that way assist the action of the bail. When the gyro has attained its normal north and south position the bubble will remain stationary or will vibrate equally on both sides of its normal position if the ship is rolling.

(7) After the gyro has been brought to full speed and is on the meridian, synchronize all repeaters and connect them to the master compass.

When the gyro is running careful attention should be paid to all switchboard instruments and indicators to see that circuits are in normal condition.

In case of failure of the direct current supply to the motor generator the gyro will continue to run with sufficient speed to maintain its directive force for about two hours. In case of momentary failure of direct current, such as would be caused by a fuse blowing, the gyro motor should be disconnected from the generator. When supply is re-established the motor generator should be brought to normal speed before connecting it to the gyro motor.

The phase indicating lamps at the top of the board in Fig. 29 are normally short circuited by the three-pole switch below the ammeter. To ascertain whether or not all phases are in operation open the three-pole switch; a glow in all of the three lamps indicates that current is flowing in all phases. In case of failure of one phase speed of the motor-generator should be reduced to about two thirds of normal running speed. Gyro motor will continue to run on two phases but if shut down will not start unless all three phases are operative.

The compass may be left running for months without any appreciable wear on the bearings, but it is best to shut down when the ship is to be in port for more than two or three days.

To shut down: (1) Stop motor generator, (2) disconnect gyro motor, (3) throw gyro motor switch to position marked "stopping," (4) start motor generator and run at a sufficient speed to maintain a reversing current of three amperes on the gyro motor, (5) disconnect repeaters, (6) open twenty volt supply to azimuth motor and repeaters, (7) stop motor generator. Gyro wheel will come to rest in about twenty minutes. Azimuth motor should be kept energized until gyro wheel has come to rest.

Remember (a) to keep the compass covered, (b) to start gyro at least two hours before getting underway, (c) to turn current on azimuth motor before starting gyro, (d) to accelerate gyro by maintaining a flow of three amperes, (e) that a correct running speed is indicated by a flow of one ampere at one hundred and thirty volts, (f) that compass will come to the meridian automatically by reason of the earth's rotation but may be placed on the meridian by hand in much less time, (g) that the azimuth motor should be kept energized while stopping the gyro.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

AN IMPROVEMENT IN FLOATING DRY DOCKS.

By CIVIL ENGINEER A. C. CUNNINGHAM, U. S. Navy.

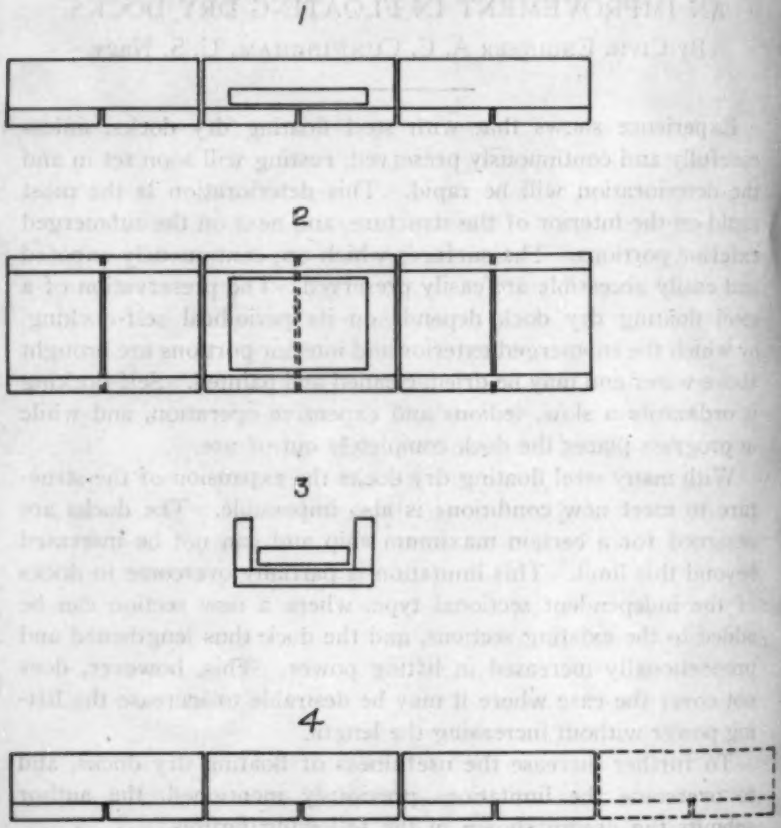
Experience shows that with steel floating dry docks, unless carefully and continuously preserved, rusting will soon set in and the deterioration will be rapid. This deterioration is the most rapid on the interior of the structure, and next on the submerged exterior portions. The surfaces which are continuously exposed and easily accessible are easily preserved. The preservation of a steel floating dry dock depends on its periodical self-docking, by which the submerged exterior and interior portions are brought above water and may be dried, cleaned and painted. Self-docking is ordinarily a slow, tedious and expensive operation, and while in progress places the dock completely out of use.

With many steel floating dry docks the expansion of the structure to meet new conditions is also impossible. The docks are designed for a certain maximum ship and can not be increased beyond this limit. This limitation is partially overcome in docks of the independent sectional type, where a new section can be added to the existing sections, and the dock thus lengthened and proportionally increased in lifting power. This, however, does not cover the case where it may be desirable to increase the lifting power without increasing the length.

To further increase the usefulness of floating dry docks, and to overcome the limitations previously mentioned, the author submits the design shown in the following figures:

Fig. 1 is a sectional side elevation; Fig. 2, a plan view; and Fig. 3, an end elevation; all showing a pontoon self-docked. It will be seen that this design is a combination of the principles of the Rennie pontoon dock and the Cunningham sectional dock, in which the sections are integrally connected together above the normal water line. The first gain is in the ease and rapidity of self-docking. There is no change or disturbance of moorings.

A pontoon is taken out sideways and docked as an independent vessel. If an extra pontoon is provided, the dock is only out of commission during the time taken to shift the pontoons. An important gain is the ease of continuous and thorough preservation. The pontoons may be periodically docked in rotation, and the preservation effected before deterioration has begun. In fact,



with this type of dock there need be no deterioration from rusting, and the dock can be kept in continuous use at the same time, when an extra pontoon is provided, as in Figs. 1 and 2.

This design of dock has the advantage of possible longitudinal expansion, the same as an independent sectional dock, as shown in Fig. 4. In this figure an original three section dock shows a fourth section added in dotted lines. This has an added ad-

vantage over the independent sectional type, in that, if the four section dock is separated at the center into two smaller docks, each part retains the self-docking feature.

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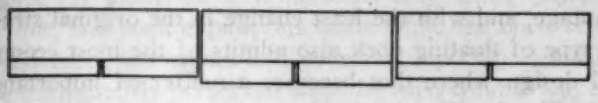

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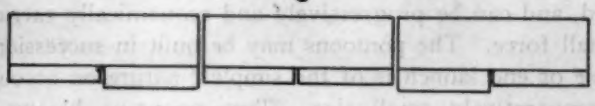

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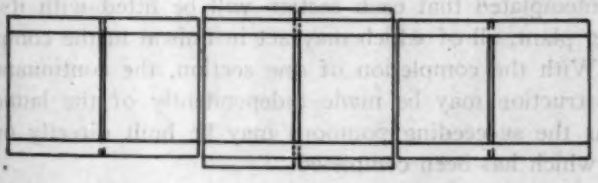

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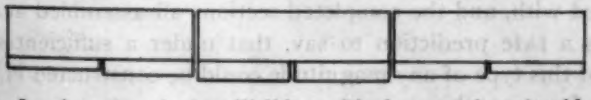

As a floating dry dock will lift a ship longer than itself, it may become desirable to increase the lifting power of a dock without increasing its length. This may be done with this type of dock by replacing some or all of the original pontoons with deeper ones as shown in Fig. 5. These new and deeper pontoons may also be

shifted to points of maximum load for special cases, as shown in Fig. 6. This increase in lifting power may also be accomplished by increasing the length of the new pontoons instead of the depth, as shown in Fig. 7. Where increased lifting power is secured with longer pontoons, the original pontoons may be lengthened to advantage, and with the least change in the original structure.

This type of floating dock also admits of the most economical original design where that becomes a matter of importance, as shown in Fig. 8. The depth of pontoons and the gauge of material in the side walls may be proportioned and distributed with reference to the curves of weight and stress so that there will be the least excess of material over that required at any point.

The construction of this dock becomes the simplest of any yet proposed, and can be progressively and economically carried on by a small force. The pontoons may be built in succession and their side or end launch is of the simplest nature on account of their comparatively small size. Two pontoons having been gotten overboard, the erection of the side walls on one section may be begun in place. When two sections are completed they will be connected with each other, and so on progressively until the entire completion of the dock. For the greatest elasticity in use, it is contemplated that each section will be fitted with its own pumping plant, all of which may act in unison in the completed dock. With the completion of one section, the continuance of the construction may be made independently of the launching ways, as the succeeding pontoons may be built directly on the section which has been completed.

While the dock admits of progressive construction, it is also possible of the quickest construction of any yet proposed. All pontoons may be constructed simultaneously and the side wall material fabricated at the same time. With the launch of the pontoons the erection of the side walls on all pontoons may be proceeded with, and the completed sections all assembled at once. It seems a safe prediction to say, that under a sufficient stress a dock of this type of any magnitude could be constructed in from three to four months.

Summarizing the preceding statements, we have in this proposed type of self-docking steel floating dock the following advantages and improvements: A dock that can be built either progressively, or in the shortest possible time of any type yet

proposed on account of the possibility of working on all parts at once. One that can be constructed in a very limited space with small facilities, and completed and assembled at the most convenient point. A dock that begins to be operative with the completion of any one section. One that can be expanded in lifting power alone, or in dimensions and lifting power at the same time, and such expansions made while the dock remains in use. Of more immediate and constant importance, a dock that can be continuously preserved with the least trouble and expense, without risk, and be continuously available for use at the same time.

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THE DESTRUCTION OF THE U. S. STEAM FRIGATE *MISSOURI* AT GIBRALTAR, AUGUST 26, 1843.

By Surgeon A. Farenholt, U. S. Navy.

The loss by fire of the U. S. Steam Frigate *Missouri* at Gibraltar during the night of August 26, 1843, was a most deplorable accident and attracted at the time more widespread comment than any other similar accident has before or since. It came at a time when the U. S. Navy had recently suffered an unfortunate series of disasters. The sloop-of-war *Peacock* was lost off the Columbia River bar, July 18, 1841, all saved. The sloop-of-war *Concord* was beached and became a wreck, October 2, 1842, off the East Coast of Africa, three were drowned, and the small sloop *Grampus* foundered off Hatteras during the early part of March, 1843, and all hands were lost.

The adoption of steam as a method of propulsion for vessels of war was first used by the United States, and the first vessel so equipped was the *Fulton the first,* built at New York in 1814. She was a hybrid vessel of 2000 tons, mounting a battery of 30 guns; she had two separate hulls with the propelling paddle wheel between them, the engines being in one hull and the boilers in the other. This vessel remained at the New York Navy Yard practically her whole life, much of the time as a receiving ship, and finally was destroyed there by an accidental explosion, June 4, 1829. Our next steamer was the *Fulton the 2d,* a small paddle vessel which did considerable work and was finally wrecked near Pensacola in 1859. The third was the small tug *Engineer* purchased in Baltimore in 1836, and used chiefly at the "Norfolk station," as it was called in those days.

With this meager ancestry the more regular steam navy may be said to have been inaugurated with the building of the *Mississippi* and the *Missouri,* two splendid sister ships, the equal of any

in the world and the pride of the country. They were built under the personal supervision of Commodore M. C. Perry who has been referred to as the "father of the steam navy." They were laid down in 1839, and completed in 1841, the *Mississippi* at Philadelphia and the *Missouri* at New York. The former proved to be a most useful vessel, she made six cruises in all, circled the globe twice and was finally burnt to prevent capture in the river whose name she bore, March 14, 1863. Strangely enough both of these pioneer ships met their ultimate fate in the same manner, destruction by fire. Some data concerning these vessels may prove of interest as showing the wide step between them and the modern *Dreadnought*.

Class, steam frigate, paddle.
Rig, bark.
Tonnage, 1692.
Cost, $567,500.
No. of engines, 2; kind, side lever.
No. of boilers, 4: kind, flue, copper.
Diam. cylinders, 75 inches.
Length of stroke, 7 ft.
Diam. paddle wheel, 28 ft.
Width paddle wheel, 11 ft.
Width of paddles, 3 ft.
Dip of paddles, 6 ft.
Number of paddles, 21.
Spread of canvas, 19,000 sq. ft.
Av. speed knots, 7-10.
Crew, 270-500.
Battery, 2 10-inch; 8 8-inch.
Length, 225.
Depth, 23.6.
Av. rev. per min., 11.
Av. steam pressure, 12 lbs.
Sq. ft. fire surface, 5400.
Av. consumption coal per hour, 2800 lbs.
Tons of coal carried, 550.
H. P., nominal, 458; actual, 650.

The following account of the *Missouri's* unfortunate loss is based upon a pamphlet published at Boston in 1843, by William Bolton, one of her crew.

Under the command of Captain John Thomas Newton, with a crew of 384 men, the vessel left Norfolk during the afternoon of August 5, 1843, having on board the Hon. Caleb Cushing, the recently appointed minister to China, and his suite, who were to be carried as passengers as far as Alexandria, Egypt. Her only service prior to this diplomatic mission and subsequent to her original commission was a short cruise to the West Indies, during which an unsuccessful attempt had been made to turn her smoke into her paddle-wheel houses. She was the first steam frigate to cross the Atlantic, and made the port of Fayal in 12½ days. During the passage over it was recorded that the deck force did not take kindly to the frequent hoisting of ashes, a new duty for them, but rather an old one at the present time, and, that in order

to stimulate cheerful compliance with such orders from the boatswain's mate as, "lay aft all the st'b'd watch of the fore topmen and hoist cinders," extra grog was frequently served. The ship was coaled from a small English brig during the short stay at Fayal. There the crew enjoyed the fresh fruits brought off by the bumboatmen and the master at arms had the usual trouble with visitors over liquor smuggled on board, often in skins secreted in cheeses or fowls. The ship remained there over Sunday and the captain, as was then customary, performed divine service. Fires were kindled and under sail and steam the ship left the harbor Sunday afternoon. The coal recently taken on board was found to be excellent in quality and the "incrustations on the fire grates" considerably reduced, the "cinder hoisting lessened one half and the speed increased.

During the afternoon of the 25th, the ship anchored at Gibraltar in "a quarter less four, abreast of the quay." Early the next morning hammocks were piped, boats lowered, tackle got up and rove; breakfast was piped and the bumboats came and left the ship. At 10 o'clock the port was saluted with 17 guns which was answered from the Rock and, the water and coal having come alongside, the men were told off to get it on board. This work lasted all day without incident. Suddenly, at about five minutes past eight, and apparently without slightest warning, a boatswain's mate who was stationed on the st'b'd hammock netting attending to the whipping of the bags on board, saw flames rising from the fore hatch. He cried "ring the bell! fire!" and after some slight preliminary confusion, during which a young drummer boy becoming frightened after giving his drum a few taps, ran aft and dived overboard through one of the open stern ports, all hands were got up and the fire energetically fought. Fire lines were formed and every bucket in the ship requisitioned; the "double boxed engine pumps" were manned and fire hose stretched.

The fire * had started in the fore hold where hemp, oil, turpentine and paint were stored and had very rapidly gained headway. The first lieutenant was on deck before the bell ceased ringing. He ordered the usual preparations and proceeded below at once to

* Captain J. T. Newton, the commanding officer of the *Missouri* when she was burned in Gibraltar harbor, August 26, 1843, reported to the Secretary of the Navy that the accidental breaking of a demijohn of turpentine, the fluid from which fell into a lighted lamp beneath, set the ship on fire.—C. W. S.

ascertain the origin and condition of the fire. With the gunner's mate they tried to get to the forward magazine where 2900 lbs. of powder were stored but the flames cut them off. Again entrance was tried through the manger gratings but it also was unsuccessful. The whole berth deck was soon on fire and flames shot up through the after hatchways. The gunner was given the keys to the after magazine in which 5745 lbs. of powder were stored, and ordered to "drown" it immediately, this was done. The first lieutenant then went to the fire room and, after consultation with the engineer officers, it was decided to open the Kingston valves. These were twelve in number, in bottom and bilge, and were 4½ inches in diameter. The two injection pipes, 6 inches in diameter, were also opened, and in a few minutes the water had risen to about four feet above the floor plates, driving the men on deck. A sentry was placed over the spirit room. Arm chests containing powder horns and loaded shells were hoisted by both marines and seamen and thrown over the side. The engine pumps continued to work but from this time on it became the usual story of an uncontrollable fire on a wooden ship, a fight against certain loss. A gun was ordered to be fired, an eight inch as there were no saluting guns on board, but, on account of there being many small boats around, it was not done. A signal gun was however fired at this time from the Rock, and, by order of the governor, the gates were thrown open, at that time an unprecedented courtesy. Four blue signal lights were displayed from the doomed ship, two on the "larboard" quarter, and two on the taffrail, which were answered at once by a 42 pdr. from the British line-of-battle ship *Malabar*, 74. A boat from the dockyard with 36 convicts and an engine appeared and flooded the berth deck through an after st'b'd air port. *Malabar's* pinnace came under the fore chains with a hand engine and two carpenter's mates and the latter endeavored to scuttle the ship through the side but, on account of the network of bolts, this could not be done. They then stopped up the scuppers and played water through the port hawse hole. Then came the Royal Irish sappers and played water through the st'b'd forward air port. The American ship *Rajah* and the American bark *Pons* got out their boats and saved much property, public and personal; the chronometers, paymaster's books and specie.

By this time there was about eight feet of water in the hold and the ship, having previously swung with the light wind, was touch-

ing the bottom. The British steamer *Locust* got underway and coming close aboard hailed and offered to tow the *Missouri* into deeper water, but this could not be attempted. The ends of the ship were isolated and crowded with men, the waist was a mass of ever increasing flames.

The captain had stood on the top of the wheel house during the greater part of the conflagration and, seeing the danger and uselessness of further effort, ordered "men save yourselves." Without unseemly haste the ship was abandoned. Both "steering-sail booms" carried away with the weight of men but all hands were rescued by the many boats which formed a ring about the ship. Of the crew's pets a big Newfoundland dog was saved but a bear, a mascot from the *Ontario*, could not be induced to leave and perished on board.

Within seven minutes after the captain had left the side the mainmast fell and, shortly after, the two forecastle Paixhan guns dropped through the deck, one of them exploding. At about 2 o'clock in the morning the forward magazine, the vessel having careened to port, detonated and tore the whole forward part of the ship out. The hulk and the coal burned until past 8 o'clock the following morning. About 200 of the crew were taken to the *Malabar* where food, rest and clothing were supplied them. "Middies" were described as "running around with lieutenants' uniforms reaching nearly to their heels," and the men "resembled a parcel of Mexican recruits or Botany Bay deserters." The next day was Sunday, and after the Episcopal service had been read by the captain, the crew proposed to take up a collection for the unfortunates but this was declined, chiefly because the *Malabar's* men had recently helped two other crews under similar circumstances. The American ship *Rajah* was at once chartered to take the men to Boston and on Sunday evening they were put on board, the remainder of the ship's company being rounded up from the various vessels in the harbor, from the Barracks and from the wine houses ashore. No one was lost. On the following day the captain mustered his crew on the *Rajah*, thanked them and "recommended a continuance of discipline and subordination."

A week was spent in saving property which included portions of the rigging, sails, two bowers, st'b'd sheet, kedges, fifteen fathoms of chain, ship's coppers and a quantity of iron.* Captain

*Captain Newton was tried by court-martial, in 1844, for "negligence," and was sentenced to two years suspension.—C. W. S.

Newton with some officers and a few of the men remained behind to further dismantle the wreck.

On the voyage home the *Rajah* was very crowded and uncomfortable, "rugs" were issued instead of hammocks and wet and stormy weather was encountered. On the forty-second day the ship arrived at Boston and the men were taken on board the receiving ship *Ohio* that afternoon. A short time after this disaster Congress appropriated $60,000 to remove the wreck and obstruction from the harbor.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

COORDINATION BEFORE AND DURING WAR.

By CAPTAIN F. K. HILL, U. S. Navy.

World politics and national policies are subjects which vitally interest every citizen of a great and growing country like the United States, but they seem to be more especially the business of our statesmen, our naval and our military officers.

It is from the point of view of the naval officer that this article is written because it seems to the author that in the higher ranks of the profession a knowledge of world politics and national policies is essential. The naval officer in peace times as well as during war is often required to act on his own initiative in national situations where errors due to lack of knowledge might produce grave results.

This article will endeavor to show that war is usually caused by a policy pursued by one nation, which policy produces antagonism in another nation or nations; that war being the result of the enforcement of a policy, must be conducted to obtain the object sought by the policy and that the treaty which ends the war must be drawn to safeguard that policy, if the nation which was enforcing it is successful, or must definitely withdraw that policy if that nation should be defeated.

Having established the truth of the above statements, a deduction will be made from them to show that a war will be properly carried on when the statesmen, who control the steps preceding and subsequent to war, work with and sustain the two military branches in harmonious plans during war, which plans are drawn to further the policies which caused the war; and further that it is necessary for the military commanders to study and broadly comprehend the policies of governments so that their plans will fit the ends to be attained.

Finally a plan will be suggested by which both the preparation for war and the conduct of war will be coordinated.

Every great country has certain policies which are adapted to the needs of that country and these policies are used as guides in the conduct of its affairs with other countries.

These policies are usually developed by the necessities of the country adopting them either to insure the territorial integrity of the country itself or else to further its interests in order that the country may derive the greatest material benefits therefrom.

The United States has at the present time two great policies: First, The Monroe Doctrine, which was originally drawn up as a defensive measure against the Holy Alliance and by which the integrity of the United States (as well as other American countries) was guaranteed against European encroachments, and, second, The Open Door policy, which is a recent development calculated to give equal opportunity to all nations in the markets now being developed in the Far East. The aim of both these policies as far as we are concerned is to enhance the power of the United States in political and commercial fields.

Another policy recently adopted is that of the exclusion of Asiatics, which policy has for its object the maintenance of a high standard of living for the citizen laborers of the United States.

The policies of a nation are almost of necessity antagonistic to the people of some other nation or nations, for they are usually formulated for the aggrandizement or protection of the nation adopting them. If a policy gives certain advantages to the citizens of a state, necessarily the citizens of some other state are placed at a disadvantage; and the friction developed by the struggle for advantage will if sufficiently great either produce war or one of the nations involved must submit its will to the other because it is less strong or not well prepared to prosecute a war.

This statement does not mean that when a country becomes prosperous others must necessarily lose in prosperity, but it does mean that the rise in power of any state results in a relative diminution in power or prestige of another state or states.

The Monroe Doctrine has frequently in the past caused considerable friction between the United States and European countries, and there was a direct threat made by the United States against England in the Venezuelan case which, if England had not

acknowledged the right of the United States, would have resulted in war. Again, the Open Door policy in the Far East has also caused considerable friction. Although at the present time (1912) most of the great powers have declared in favor of the Open Door, yet nevertheless time may develop a condition in which one or more of those countries may think it advantageous to bring forward or revive the policy of "Sphere of Influence" and do away with the Open Door. The Sphere of Influence policy gives the nation dominant in the Sphere special rights and is directly contrary to the Open Door policy. England, Germany, and Japan are great rivals of the United States in manufactures and as they all aspire to Spheres of Influence in China, it is probable that, if in the race for commercial supremacy any one of these countries finds that it is being outdistanced by a rival, then that country would endeavor by a change from the "Open Door" to the "Sphere of Influence" policy to regain the lost ground.

Japan having seized Corea and also being already partially established in Manchuria is thus geographically near to China and could pass most readily to the "Sphere of Influence" policy if she thought that thereby she might gain an advantage over her rivals in trade.

The decision as to what policies a republic is to pursue rests primarily with the people and is expressed by their agents temporarily in control of the Government. In the United States the President, Secretary of State, and the Houses of Congress (more especially the Senate) are the custodians or the directors of the policies of the people and they must decide what policies shall be carried through in spite of all opposition by foreign countries. This brings it directly to the President and his assistants to decide which policies the country is able to carry through, and in reaching this decision he must consult the naval and military authorities in order to get their expert advice as to the power of the United States to enforce its will on foreign states; in other words, to wage a successful war. It would be useless or inexpedient to put forward a policy as one for which the United States would fight if at the time its naval and military forces could not expect to cope successfully with the probable enemy. If, after consultation, the President finds that certain policies, which would bring on friction with special foreign states, are not capable of being carried through with the present naval and military forces and

yet the policies are of such vital importance to the growth of the country that they are considered essential, then the naval and military advisers should be called on to state what additional forces are necessary in order that these policies may be safeguarded from interference by foreign states. If this method were pursued the United States would never find itself in the undignified position of having advocated a certain policy and when this policy was opposed of having to withdraw it because adequate forces were not available to withstand the pressure brought to overthrow the policy. It certainly would be more dignified as a nation not to assert any policy which could not be carried out in spite of foreign pressure, rather than to proclaim much and then back down.

After the President had ascertained from his naval and military advisers what forces were necessary to enforce policies it would then be his duty to call the attention of Congress to the necessary appropriations to this end, and Congress would then make these appropriations, based on technical advice or assume the responsibility either for doing away with the policy or for the defeat of United States forces in event of war.

It seems axiomatic that Congress is unable to decide technical questions of defense or attack, but Congress may decide what policies are necessary and what policies may be abandoned and finally what forces they will provide, and having made the decision it is then incumbent upon Congress to assume the responsibility for the lack of preparation if such condition is not due to the advice of the experts. On the other hand, it is equally the duty of the naval and military advisers to assume all responsibility for bad conduct of war when adequate facilities have been given to them by Congress based on their own recommendation.

We thus see that a definite responsibility can and ought to be fixed, first, for the decision as to what the policies of the Government will be; second, for the recommendation concerning the forces necessary to carry out the policies; third, for the appropriations necessary to provide these forces; and, fourth, for the right use of these forces by the military and naval commanders after they have been provided. The people of the United States who delegate power to carry on the Government should be thoroughly informed as to the various responsibilities so that the credit for success, or odium for failure, should rest where it belongs.

At present it seems to be the popular idea that statesmen are

in control up to and including the time when the solution of difficulties between nations is impossible except by resort to arms, that after that they call in the naval and military forces to cut the Gordian knot which they have been unable to disentangle, and that the making of war has little connection with the cause of the war. *These are very false ideas.*

War being the result of policies enforced should be based on strategic plans to gain certain definite ends. For instance, if the United States had a policy of extension of territory by absorption of Canada, the war would be directed so as to gain military control of that territory, and if the war ended successfully for the United States, the treaty would probably cede such territory as was held under military control at the end of the war.

It is thus seen that the strategic objective of a war must rightly comprehend a knowledge of the policies which preceded war and contemplate the treaty which is to conclude the war.

In order to make war most successfully it is not only necessary to have properly conceived strategic plans which endeavor to carry out policies, but these policies must be based on the moral convictions of the people that not only are the results of the policies beneficial to the country but also that they are ethically correct. The moral force of the nation must be behind the policy and this moral force must be developed in the people so that every ounce of the strength of the nation will be exerted throughout the war. All wars gather strength from the intensity with which the people enter into the spirit of upholding the policy adopted. A war waged in a lukewarm spirit is worse than useless, and it would be better not to enter into war unless it is known that the fight will have the backing of the people to the bitter end.

A most striking illustration of a policy carried forward aggressively and with the backing of the people is that of Germany in her industrial expansion at the present time. She has put her hand to the plough and has systematically developed her navy, merchant marine and industries to the end that nothing shall impede her progress in this direction. The people are imbued with the spirit of the thing or otherwise it would never have been possible to impose the taxes to raise the money for carrying out those projects which are the *adjuncts of the main object.*

So we see that policies make war; that war is conducted to further policies, and that treaties carry forward these policies when war decides in their favor.

It has been mentioned above that the President in reaching a decision as to which policies the country is able to carry through must consult the Naval and Military authorities. At this time in order to make a proper decision these experts must, having due regard to a policy to be enforced, lay out in conjunction plans of campaign. This work is done by the General Board of the Navy and the Army War College and their separate deductions are harmonized by the Joint Board. It is to be regretted that in the development of these plans an authoritative representative (a State Department Official) is not assigned to duty on the Joint Board. The harmony of the essential parts of the military plans will follow when the Navy and Army work more closely together, but the harmony of the full campaign *to the end to be attained* will be greater if Executive representation is combined with the Military in the drawing up of the strategic plans.

Since these naval and military experts must base their campaigns on strategic objectives to carry out the policy, they necessarily must makes studies of foreign policies and have intimate knowledge of the existing relations of their home country to all foreign countries. On this knowledge the campaign must be founded and during the progress of the war no action must be taken which is opposed to the existing diplomatic conditions. Hence the commanders of both branches must be conversant with international conditions as well as military plans.

Admiral Mahan says, in regard to the commander-in-chief, as follows:

> While a government is responsible for its choice of the chief naval commander, it must depend upon him for the enforcement of discipline and for the choice of measures at once practicable and adequate to compass the ends of the war. Upon him more than upon any other must fall the responsibility of failure; for he knows or should know better than the government, what the fleet can be made to do, what the state of discipline really is, and what his own capacity to carry out the one and support the other. Only through him can the government act. When it disregards or over-rides without displacing him mischief ensues; but the correlative of the generous, confident, and hearty support it owes him are on his part unceasing intense effort, or resignation.

No better exposition from a purely naval point of view could be given than the above, but it is respectfully submitted that to carry out what is required will necessitate a complete understanding of diplomatic conditions by the commander-in-chief, which conditions must be the basis of his strategic plans.

The plans, therefore, should be developed after discussion between representatives of the State, War and Navy Departments. The first understanding the conditions and the latter two the methods of carrying out the conditions. The war following the plans should ever have in mind the conditions which formed the basis of the plans. The plans may be modified or adjusted but the conditions will always remain fixed.

We see, therefore, in the first place, that under all circumstances war is to be regarded not as an independent thing, but as a political instrument; and it is only by taking this point of view that we can avoid finding ourselves in opposition to all military history. This is the only means of unlocking the great book and making it intelligible. Secondly, this view shows us how wars must differ in character according to the nature of the motives and circumstances from which they proceed.

Now, the first, the grandest, and most decisive act of judgment which the statesman and general exercise is rightly to understand in this respect the war in which he engaged, not to take it for something, or to wish to make of it something, which by the nature of its relations it is impossible for it to be. This is, therefore, the first, the most comprehensive, of all strategical questions. (Clausewitz.)

CONCLUSIONS.

War is not independent of political considerations, but must be outlined and carried on with due regard to these considerations. That to properly outline the war the three branches of the Government (State, War and Navy Departments) should act in conjunction, and that peace preparation in anticipation of war should be the joint action of Congress, the War and the Navy Departments.

Finally both the peace preparations and war will best be carried out by a National Board for Defense comprised of units representing both branches of Congress and the Departments of State, War and Navy.

The following is suggested as the composition of the National Board for Defense:

Secretary of State.
Secretary of War.
Secretary of the Navy.
Chairman of Senate and House Military Committees.
Chairman of Senate and House Naval Committees.
Chief of Staff, Army.

President of Army War College.
Naval Aid of Operations.
President of Naval War College.
One Permanent Secretary.
Civilian under State Department.

For the information of this board it is necessary to have as its head the Secretary of State, who knows about the diplomatic relations which may precipitate war; it is necessary to have the legislative members so that they may decide on the policies to be carried out and the expenditures required to prepare for war, and it is necessary to have the military branches which will furnish technical information as to preparation for war and from the discussion of the board will understand the policies to be enforced in the prosecution of war, and so draw the strategic plans that the object of the war may most fully be accomplished.

EDITOR'S NOTE.—The House Naval Committee during week ending April 27, 1912, favorably reported the bill H. R. 1309, establishing the Council of National Defense as is herein proposed, except that the chairmen of the Senate and House Committees on Appropiations and on Foreign Relations are added to the council. The Naval Aid of Operations is not designated as such, but as an officer of the navy not below the rank of captain.

COUNCIL OF NATIONAL DEFENSE AS CONSTITUTED BY THE FOLLOWING NATIONS:

FRANCE.

PARIS, April 3, 1906.

ARTICLE 1. A supreme board of national defense is instituted for the examination of all questions requiring the cooperation of two or more ministerial departments.

ART. 5. The supreme board of national defense shall be composed of: The president of the board of ministers, presiding; the minister of foreign affairs; the minister of finance; the minister of war; the minster of marine; the minister for the colonies.

ART. 6. The chief of staff of the army, the chief of staff of the navy, and the president of the consultative committee for colonial defense shall be present at meetings of the supreme board with deliberative voice.

RUSSIA.

(This and a great general staff were created by the Emperor of Russia as a result of the experience of the Russo-Japanese War.)

The board of national defense is charged with the study of questions which relate to the security of the Empire. It acts under the direct orders

of the Emperor, and is made up of a president and six permanent members —all named by the Emperor—but has also a certain number of other members, some on account of the office which they hold, as the ministers of war and of the navy, the chief of the general staff, the chief of the great general staff of the navy, and the inspectors of the army, and others because of their personal knowledge or because of the needs of the service as, for example, ministers, commanders of army corps, etc.

The board of national defense has the following duties:

(a) Study of general measures so that a fixed plan may be determined upon by the ministers of war and of the navy in order to assure the development of the military power of the Empire in conformity to the political ends which it is desired to accomplish.

(b) To watch that these measures are carried out as soon as they have the approval of the Emperor.

(c) Study of propositions emanating from the military ministers and conforming them to order that all resources may be employed in time of war and unification and direction of all preliminary measures.

(d) Study of modifications which it is desirable to make in the plans of the two military ministers.

(e) Study and solution of the questions of the fitness of the different branches of the administration and the differences which exist in them from the standpoint of national defense.

The board of national defense has no executive power, but is limited to recommendations to the Emperor. The execution of measures which receive the approval of the Emperor is in charge of the minister of war. The president has direct communication with the Emperor, and speaks as his mouthpiece when he presides in the board. Said president forms a part by virtue of his office of the imperial council and of the council of ministers. He has the right to ask from the various ministers anything which can contribute to the work of the board, and receives from the minister of war, of the navy, and of foreign affairs information relating to the national defense. All the deliberations and actions of the board are considered as state secrets. (Revista Cientifico-Militar y Biblioteca Militar, 25 Septiembre, 1905.)

ITALY.

By a decree of the 16th of July, 1897, the Supreme Mixed Commission for the Defense of the Empire was organized. This is charged with the duty of giving advice on all important questions concerning the defense of Italy. The Duke of Genoa is president; the members are: the admiral president of the superior council of the navy, the generals designated to command the various armies in case of war, the admirals designated to command the fleets, and the chief of the general staff of the army and of the navy. The generals, the commanders of army corps, the inspectors general and admirals, when it appears that their presence will be useful, may be invited to attend the meetings of the commission for consultation only. (L'Etat Militaire des Principales Puissances Etrangeres en 1902, Lauth.)

SPAIN.

Spain has a consultative board for war which is concerned with the large questions in reference to preparation for war, etc. The organization and the composition of this board are regulated by decisions made in the council of ministers. (L'Etat Militaire des Principales Puissances Etrangeres en 1902, Lauth.)

JAPAN.

The Japanese have what is known as the "Supreme Military Council," composed of the Minister of Foreign Affairs, representing the diplomatic side, four general officers and two flag officers. This was created in 1898.

The Supreme Council of War, which was created in 1904, is an addition to the "Supreme Military Council." This Supreme Council of War may be regarded as the Emperor's advisers and staff officers on all important matters pertaining to war. It consists of the personnel of the "Supreme Military Council," the Ministers of War and of the Navy, the Chiefs of the General Staff of the Army and the Naval Staff Board. (Taken from Japan Year Book, 1907.)

GREAT BRITAIN.

Matters of naval and military policy are considered by a committee of the cabinet called the "Defense Committee." It is presided over by the Prime Minister and always includes the Secretary of State for War, the first Lord of the Admiralty, the Secretary of State for Foreign Affairs, and for India, the Chancellor of the Exchecquer, the Chief of the General Staff, the Director of Naval Intelligence, the first *Sea* Lord of the Admiralty, and the Director of Naval Operations. Other naval and military officers of rank and experience are asked to attend from time to time.

AUSTRO-HUNGARY.

The War Ministry includes both the army and the navy. The War Minister, always a general officer of high rank, is the head of the Imperial War Office, and under him are the Austrian and Hungarian Defense Ministers. The navy of Austria, being mainly a coast defensive force, is administered by the Naval Department of the Ministry of War. Common to the two states of Austro-Hungary are Foreign Affairs and Military and Naval Affairs.

The Council of National Defense consists of the Emperor, the Ministry of Foreign Affairs and the Ministry of War. The Austrian General Staff cooperates with the Naval Department of the War Ministry in the formulation of all war plans. These plans are then laid before the Council of National Defense, which either accepts them or returns them with such suggestions as may be deemed advisable from a diplomatic point of view. In this way all matters relating to war and preparations for war are solved, the system in vogue being an ideal one. The nucleus of a plan is evolved by the Council of National Defense; this is then laid before the general staff, which in turn works out the military solution, returns it, and thus, between the two bodies, a solution of all plans is finally arrived at which, once accepted, is adhered to.

EXTRACTS FROM VARIOUS AUTHORITIES BEARING ON THE SUBJECT OF THE PRECEDING ARTICLE.

VON DER GOLTZ.

CONDUCT OF WAR.

"Upon policy the whole condition, the feeling, the constitution, and the moral and physical affairs of a state depend; and upon these depend, again, the waging of war.

"Policy, again, regulates the relations not merely of those states immediately concerned, but also those of such as are indirectly interested in the final issue. Their favor or disfavor may be of very great significance, impeding the course of events, or promoting them. Politics, again, as a rule, determine the moment for the outbreak of hostilities, upon the happy choice of which much depends. They, in short, create the general situation, in which the state enters into the struggle, and this will be of material influence upon the decisions and attitude of the commander-in-chief, and even upon the general esprit of the army.

"In the face of the great weight of warlike events in our modern times, politics retreat more and more into the background, as soon as the cannon thunder.

"Politics regain their influence only so soon as it is felt that, in the case of one of the belligerents, the desire for peace begins to prevail over his desire for continuing the struggle, and that all hope of the success of his arms is dying away. It will then be for politics to bring about a rapprochment under which both parties can arrive at an understanding respecting the end of the struggle. The influence of third powers, too, must not be lost sight of. It frequently determines how far the victor may proceed in his demands, and how far and to what extent the vanquished must give way.

"In the last stages of a war, when the issue and decision by arms is no longer doubtful, the military element naturally makes way more and more for the political. The effect of politics frequently makes itself immediately felt in the decisions of the commander-in-chief. Political considerations may, under certain circumstances, bring about a battle which, although no longer necessary from a purely military point of view, is regarded on the one side as a last attempt, and on the other as final means of coercion. One of the belligerents, perchance, does not desire this final decision for its own sake. A weak government requires it in order to explain to its own people the necessity for peace, even when it had no longer hopes of victory. What marvelous fruits the interference of politics at the end of a war may bring forth, was seen in 1871, when an armistice was concluded, whilst on another part of the theater of war the struggle was still being carried on; just like two fencers who have been separated before their courage has cooled down.

"War serves politics both before and after. War waged only for annihilation and destruction is in these days inconceivable. An end and aim that is of permanent value to the state, be it only a question of ascendancy, must be existent; and this can only arise from political considerations.

"The object of a war is of such importance and will be of such lasting

effect upon the exertions which nations make to attain it, that we ought, almost on that account alone, to place policy first among conditions of success. Now, as we have here pointed out, many motives are also attendant, and thus we may without hesitation lay down a maxim that without a good policy a successful war is not probable.

"War will, on that account, be in no way degraded in importance nor restricted in its independence, if only the commander-in-chief and the leading statesmen are both clear that war, under all circumstances, serves politics best by completely defeating the enemy. By attention paid to this maxim, not only is the greatest liberty assured to politics, but, at the same time, the widest scope is allowed in the employment of the combative forces.

"How heartily politics and war ought to co-operate is manifest."

CLAUSEWITZ.

ON WAR.

"Here the question which we had laid aside forces itself again into consideration, viz.: the political object of the war. The law of the extreme, the view to disarm the adversary, to overthrow him, has hitherto to a certain extent usurped the place of this end or object. Just as this law loses its force, the political object must again come forward. If the whole consideration is a calculation of probability based on definite persons and relations, then the political object, being the original motive, must be an essential factor in the product.

"Thus, therefore, the political object, as the original motive of the war, will be the standard for determining both the aim of the military force and also the amount of effort to be made.

"Now, if we reflect that war has its root in a political object, then naturally this original motive which called it into existence should also continue the first and highest consideration in its conduct. Still, the political object is no despotic law giver on that account; it must accommodate itself to the nature of the means, and though changes in these means may involve modification in the political objective, the latter always retains a prior right to consideration. Policy, therefore, is interwoven with the whole action of war, and must exercise a continuous influence upon it, as far as the nature of the forces liberated by it will permit.

"We see, therefore, that war is not merely a political act, but also a real political instrument, a continuation of political commerce, a carrying out of the same by other means. All beyond this which is strictly peculiar to war relates merely to the peculiar nature of the means which it uses. That the tendencies and views of policy shall not be incompatible with these means, the Art of War in general and the Commander in each particular case may demand and this claim is truly not a trifling one. But however powerfully this may re-act on political views in particular cases, still it must always be regarded as only a modification of them; for the political view is the object, War is the means, and the means must always include the object in our conception.

"We see, therefore, in the first place, that under all circumstances War is to be regarded not as an independent thing, but as a political instrument;

and it is only by taking this point of view that we can avoid finding ourselves in opposition to all military history. This is the only means of unlocking the great book and making it intelligible. Secondly, this view shows us how wars must differ in character according to the nature of the motives and circumstances from which they proceed.

"Now, the first, the grandest, and most decisive act of judgment which the statesman and general exercise is rightly to understand in this respect the war in which he engages, not to take it for something, or to wish to make of it something, which by the nature of its relations it is impossible for it to be. This is, therefore, the first, the most comprehensive, of all strategical questions.

"War is, therefore, not only chameleon-like in character, because it changes its color in some degree in each particular case, but it is also, as a whole, in relation to the predominant tendencies which are in it, a wonderful trinity, composed of the original violence of its elements, hatred and animosity, which may be looked upon as blind instinct; of the play of probabilities and chance, which make it a free activity of the soul; and of the subordinate nature of a political instrument, by which it belongs purely to the reason.

"The first of these three phases concerns more the people; the second, more the General and his Army; the third, more the government. The passions which break forth in war must already have a latent existence in the peoples. The range which the display of courage and talents shall get in the realm of probabilities and of chance depends on the particular characteristics of the general and his army, but the political objects belong to the government alone."

JOMINI.

THE ART OF WAR.

"The art of war, as generally considered, consists of five purely military branches: viz., Strategy, Grand Tactics, Logistics, Engineering, and Tactics. A sixth and essential branch, hitherto unrecognized, might be termed Diplomacy in its Relation to War. Although this branch is more naturally and intimately connected with the profession of a statesman than with that of a soldier, it cannot be denied that if it be useless to a subordinate general, it is indispensable to every general commanding an army; it enters into all the combinations which may lead to a war, and has a connection with the various operations to be undertaken in this war; and, in this view, it should have a place in a work like this.

"To recapitulate, the art of war consists of six distinct parts:

"1. Statesmanship in its relation to war.

"2. Strategy, or the art of properly directing masses upon the theater of war, either for defense or for invasion.

"3. Grand tactics.

"4. Logistics, or the art of moving armies.

"5. Engineering—the attack and defense of fortifications.

"6. Minor tactics."

STATESMANSHIP IN ITS RELATION TO WAR.

"Under this head are included those considerations from which a statesman concludes whether a war is proper, opportune, or indispensable, and determines the various operations necessary to attain the object of the war.

"War is always to be conducted according to the great principles of the art; but great discretion must be exercised in the nature of the operations to be undertaken, which should depend upon the circumstances of the case.

"To these different combinations, which belong more or less to statesmanship, may be added others which relate solely to the management of armies. The name Military Policy is given to them; for they belong exclusively neither to diplomacy nor to strategy, but are still of the highest importance in the plans both of a statesman and a general."

SPENSER WILKINSON.

THE BRAIN OF AN ARMY.

"The Emperor unites the supreme military with the supreme political control. This combination is intended to secure the first of all conditions for success in war, harmony between the political and the military direction. It is impossible to overrate the importance of accord between strategy and policy. The soldier is at all times the servant of the statesman; a relationship the loyal recognition of which implies that the soldier abstains from prescribing ends to the statesman, the statesman from interfering with the soldier in the choice of means. An exhaustive discussion of the relations between the army and the government—that is, between war and policy—lies beyond the scope of this work. But it is relevant to say that the successful conduct of a state in war as in peace, depends very largely upon the clearness with which the sovereign power conceives its political ends, and the resolution with which they are pursued. No perfection of the military organization can compensate for the failure of the statesman to frame a clear conception of his aims, or for his timidity or hesitation in the effort to attain them.

COL. G. F. R. HENDERSON, C. B.

THE SCIENCE OF WAR.

"It is hardly necessary to observe that no civilian minister, however deeply he might have studied the art of war, could be expected to solve for himself the strategic problems which come before him. In default of practical knowledge, it would be as impossible for him to decide where garrisons should be stationed, what fortifications were necessary, what roads should be constructed, or how the lines of communications should be projected, as to frame a plan of campaign for the invasion of a hostile state. His foresight, his prevision of the accidents inevitable in war, would necessarily be far inferior to those of men who had spent their lives in applying strategical principles to concrete cases; and it is exceedingly unlikely that he would be as prolific of strategical expedients as those familiar with their employment. Nevertheless, although he would be more or less bound by expert advice, and although he might be aware that the attempt

to control military operations, even so far as regards the preliminaries of a campaign, is a most dangerous proceeding, yet a knowledge of war could hardly fail to serve him in good stead. Arnold, in his 'Lectures on Modern History,' puts the matter clearly: 'There must be a point up to which an unprofessional judgment on a professional subject may not only be competent, but of high authority, although beyond that point it cannot venture without presumption and folly. The distinction seems to lie originally in the difference between the power of doing a thing and that of perceiving whether it is well done or not. "He who lives in the house," says Aristotle, "is a better judge of its being a good or bad one than the builder of it. He can tell not only whether the house is good or bad, but wherein its defects consist; he can say to the builder, 'This chimney smokes, or has a bad draught'; or 'This arrangement of the rooms is inconvenient,' and yet he may be quite unable to cure the chimney, or to draw out a plan for his rooms which should suit him better. Nay, sometimes he can even see where the fault is which has caused the mischief, and yet he may not practically know how to remedy it." Following up this principle, it would appear that what we understand least in the profession of another is the detail of his practice. We may appreciate his object, we may see where he has missed it, or where he is pursuing it ill, nay, may understand generally the method of setting about it, but we fail in the minute details. ... But in proportion as we recede from those details to more general points, first, as to what is generally called strategy, that is to say, the directing the movements of an army with a view to the accomplishment of the object of the campaign, in that proportion general knowledge and power of mind come into play, and an unprofessional person may, without blame, speak or write on military subjects, and may judge of them sufficiently.'

"Applying this wise rule to statecraft, the point where civilian control of military operations becomes presumptuous, as well as the extent of that control, may be easily defined. In the first place, to frame a sound strategical plan, whether for defense or invasion, requires not only an intimate acquaintance with innumerable details of which only a professional soldier can really judge, such as methods of supply and transport, the use of fortifications, the effects of climate, the maintenance of the lines of communication, the value of positions, the management of marches, the morale, armament, organization, tactics, and resources of the opposing forces, but an intimate acquaintance with the principles and stratagems of war. It is here that the amateur strategist fails. He may have read enough to give him a good knowledge of principles, but he has no knowledge of the practical difficulties of war, and his criticism, as a general rule, is consequently of little value. All war is simple, but the simple is most difficult, and how difficult only those who have made it, who have witnessed with their own eyes the turmoil, the confusion, the friction, which, even in the best armies, attend the most ordinary operation, are in a position to understand. Even a theoretical acquaintance, derived from historical study of the practical difficulties, is insufficient. Unless he who prepares a strategical plan has before his mind's eye a clear picture of all military opera-

tions, of marching, quartering, supply, entraining, and detraining, embarkation, and debarkation, and a personal knowledge of the difficulties which attend on war, his work will be of little value. It is essential, too, that he should have a thorough knowledge of both officers and men, of the peculiar characteristics of the army, and of the system on which it works, of its strong points and its weak. A German, suddenly placed in command of British soldiers, would be much at sea, and *vice versa*. Every army has an individuality of its own. It is a living organism of a very sensitive temper, and it can neither be properly controlled nor efficiently directed except by those who are in full sympathy with its every impulse.

"It would appear, then, that while a statesman may be competent to appreciate the general principles of the projects of operations laid before him, he should never attempt to frame a project for himself. Still less, when once he has approved of a plan of campaign, should he attempt to limit the number of troops to be employed, or to assign the position of the necessary detachments. Nevertheless, a knowledge of war may still be exceedingly useful to him. A minister of war cannot divest himself of his responsibility for the conduct of military operations. In the first place, he is directly responsible for plans of campaign to meet every possible contingency being worked out in time of peace. In the second place, he is directly responsible for the advice on which he acts being the best procurable. It is essential, therefore, that he should be capable of forming an independent opinion on the merits of the military projects which may be submitted to him, and also on the merits of those who have to execute them. Pitt knew enough of war and men to select Wolfe for the command in Canada. Canning and Castlereagh, in spite of the opposition of the king, sent Wellington, one of the youngest of the lieutenant-generals, to hold Portugal against the French. The French Directory had sufficient sense to accept Napoleon's project for the campaign of Italy in 1796. In the third place, strategy cannot move altogether untrammelled by politics and finance.

"But political and financial considerations may not present themselves in quite the same light to the soldier as to the statesman, and the latter is bound to make certain that they have received due attention? If, however, modifications are necessary, they should be made before the plan of campaign is finally approved; and in any case the purely military considerations should be most carefully weighed. It should be remembered that an unfavorable political situation is best redeemed by a decisive victory, while a reverse will do more to shake confidence in the government than even the temporary surrender of some portion of the national domains. 'Be sure before striking' and 'reculer pour mieux sauter' are both admirable maxims; but their practical application requires a thorough appreciation of the true principles of war, and a very large degree of moral courage, both in the soldier who suggests and in the statesman who approves. If, however, the soldier and the statesman are supported by an enlightened public, sufficiently acquainted with war to realize that patience is to be preferred to precipitation; that retreat, though inglorious, is not necessarily humiliating, their task is very considerably lightened.

"Nothing is more significant than a comparison between the Paris press in 1870 and the Confederate press in 1864. In the one case, even after the disastrous results of the first encounters had proved the superior strength and readiness of the enemy, the French people, with all the heat of presumptuous ignorance, cried out for more battles, for an immediate offensive, for a desperate defense of the frontier provinces. So fierce was their clamor that both the generals and the government hesitated, until it was too late, to advise the retreat of Bazaine's army; and, when that army had been cut off at Metz, the pressure of public opinion was so great that the last reserve of France was despatched to Sedan on one of the maddest enterprises ever undertaken by a civilized state. In 1864, on the other hand, while Lee in Virginia and Johnston in the West were retreating from position to position, and the huge hosts of the Union were gradually converging on the very heart of the Confederacy, the Southern press, aware that every backward step made the Federal task more difficult, had nothing but praise for the caution which controlled the movements of their armies. But the Southern press, in three crowded years of conflict, had learned something of war.

"In 1866 and 1870 the German press was so carefully muzzled that, even had there been occasion, it could have done nothing to prejudice public opinion. Thus both the sovereign and the generals were backed by the popular support they so richly merited; but, it may be remarked, the relations between the army and the government were characterized by a harmony which has been seldom seen. The old king, in his duel capacity as head of the state and commander-in-chief, had the last word to say, not only in the selection of the superior officers, but in approving every important operation. With an adviser like Moltke at his elbow, it might appear that these were mere matters of form. Moltke, however, assures us that the king was by no means a figurehead. Although most careful not to assert his authority in a way that would embarrass his chief of staff, and always ready to yield his own judgment to sound reasons, he expressed, nevertheless, a perfectly independent opinion on every proposal placed before him, and on very many occasions made most useful suggestions. At the same time, while systematically refraining from all interference after operations had begun, he never permitted military considerations to override the demands of policy."

REAR-ADMIRAL MAHAN.

LECTURE DELIVERED AT NAVAL WAR COLLEGE, 1910.

In concluding, I wish to draw your attention pointedly to one remark of Corbett's. I expect to use from him several illustrative incidents in due place; but the remark I here quote bears upon a necessary element of naval strategic thought, which used to be not only ignored, but actually discredited and decried. I mean the appreciation of political conditions as an essential factor in all military plans. I will cite an instance, immediately under our eyes. When Germany shall have finished the ships contemplated in the naval program which she has formally adopted, she will have a navy much superior to that of the United States, unless we change our present

rate of building, and also provide more extensive plants. Where then will be the Monroe Doctrine? and where the security of the Panama Canal? The enforcement of both these depends upon the fleet.

The question, if merely one of military force, would be simple; the superior fleet dominates, if the margin of superiority be sufficient. It is the question of political relations which introduces perplexing factors; and the military adviser of a government is not competent to his task, unless, by knowledge of conditions, and practice in weighing them, he can fairly estimate how far inferior numbers may be reinforced by the pressure which other considerations may bring to bear on a possible enemy. Every naval officer should order his study, and his attention to contemporary events, abroad and at home, by the reflection that he may some day be on a general staff, and in any case may beneficially affect events by his correct judgment of world-wide conditions.

I have just stated a principle, viz., the necessity of including political—international—conditions in military projects. An illustration, the complement of the principle, is the contemporary historical relations of Germany and of the United States to other nations. For instance, there is the solidarity of action between Germany and Austria, just shown by the pressure of Germany upon Russia to ignore Great Britain and France, and to recognize the Austrian annexation of Bosnia and Herzegovina. These incidents are not six months old. I cannot, of course, enter now into an elaborate analysis of all that this German action means, but I can indicate the, to us, important question involved, which is this: How far do Germany's relations with other European states permit her embarking her fleet in a trans-Atlantic adventure? If we had no fleet doubtless she could afford to do so. If we have nine ships to her ten she probably could not so afford; because the fight we could put up, whatever the issue, would leave her without a navy to confront Europe. On the other hand, should our Pacific coast citizens precipitate us into a war, or even into seriously strained relations, with Japan, that pressure upon us would add to the force of the German fleet. In our long contention with Great Britain, based on the Monroe Doctrine, we made continuous progress up to the Hay-Pauncefote Treaty of a half dozen years ago, which registered the final triumph of the Monroe Doctrine. During all this period our navy was hopelessly inferior to the British, sometimes ludicrously so, yet we won out. Why did we? and are we in similarly good condition for a possible contention with the new sea power? Where ought Great Britain to stand, in case we have trouble with Germany? and where ought we to stand, in the reverse case?

Corbett's remark is, that in the Seven Years' War, the strength of the British action lay in the fact that *one* great man, the first Pitt, controlled the naval, the military, *and* the diplomatic action. The several conditions were thus weighed, and were harmonized into a common action, to which each contributed its utmost influence in mutual support. The desirability of the result must fix our eyes upon the fact that, in our country at least, it will never be attained through one man, but only by the cooperation of several. These several will be statesmen, military men, and naval men; and, in order that their cooperation may be adequate, each must understand

the conditions by which the others are controlled. The often failure of conjoint military and naval operations has been due less to mean jealousy than to lack of such mutual understandings; and for a due grasp of preparation for war, and for planning war, military men of both services need to be imbued with knowledge of international relations. Those relations do affect the amount of force available in various quarters, by the several opponents. Thus Darrieus says correctly: "Every naval project which takes account neither of the foreign relations of a great nation, nor of the material limit fixed by its resources, rests upon a weak and unstable base. Foreign policy and strategy are bound together by an indestructible link;" and in this connection he quotes the German, Von der Goltze: "Whoever writes on strategy and tactics ought not in his theories to neglect the point of view of his own people. He should give us a national strategy, a national tactics." Now the Monroe Doctrine is a point of view of the American people; and no scheme of strategy—such as the numbers and constitution of the fleet—is sound if it neglect this consideration. The remark applies to statesmen as well as to officers.

My last word to you, then, in these preliminary remarks, is to master, and keep track of, the great current events in history contemporary with yourself. Appreciate their meaning. Your own profession, on its military side, calls of course for your first and closest attention; but you all will have time enough to read military history, appreciating its teachings, and you can also keep abreast of international relations, to such an extent that when you reach positions of prime responsibility, your glance, your coup d'oeil, to repeat the French idiom, will quickly take in the whole picture of your country's interests in any emergency, whether that be pressing or remote. To repeat Nelson's phrase, you will be no novice; and you will not, because, you, in your career, as he in his, will have been continually applying the judgment you are now called specially to exercise. That you may more effectually do this, banish from your mind all concern about questions interior to the country; questions financial, sociological, economical, or what not. The sphere of the navy is international solely; and it is this which allies it so closely to that of the statesman. Be yourselves statesmen as well as seamen. The biography and history of our profession will give you glorious names who have been both. I trust the future may show many such among the sons of this college.

DARRIEUS.

WAR ON THE SEA.

General Policy of Nations; Its Close Connection with Strategy.

It is chiefly in taking up this chapter that I feel all the difficulties of my task. In the short space at my disposal, I ought to pass in review all the elements which make up the foreign policy of a great nation, to show how it acts as the motive and regulator of strategy. This magnificent study, too vast for our limited program, would moreover exceed my ability. And yet it is indispensable for me to show, were it only in a brief statement, the intimate connection which makes military conceptions the natural consequence of political conceptions. There is no study of strategy possible

without that. It has become a common saying that: "A nation must have the fleet which corresponds to its policy." To understand the full value of this expression, it suffices to imagine the two extreme possible conclusions of the policy of a given nation: Conflict with England or with the Swiss Confederation. And at once it is clearly apparent, not only that the conduct of the war evidently cannot be the same in the one as in the other case, but furthermore that, between these two limiting cases of an exclusively naval power and another with land forces only, there exists an infinity of mixed solutions in which the relative value of the naval force is more or less great in comparison with the total military force.

The point of departure being thus clearly defined, it results therefrom that the future conduct of the operations of war, depending necessarily upon the composition of the adversary's forces, demands prior knowledge of the political objectives. There is no possible strategy, using the expression in its broadest sense, that is in its relation with preparation for war during peace times as well as in its connection with the direction given to actual operations, unless at the very beginning the probable adversary or adversaries are known. Even more, it is usually from the prior political action that military strategy derives its fundamental premises, knowledge of the enemy, of his weak points as well as of the resources at his disposal, of his moral state as well as of his material situation; in short all the information the utilization of which is the most valuable element in success. Finally, it is through politics alone that the military art can emerge from pure abstraction, wholly speculative, to solve concrete cases; it is politics which makes it fruitful.

The very foundations of the military structure rest then upon the precise designation of the nations with which causes of conflict are permanent or even liable to occur. And it is because the study of strategy would be absolutely sterile without this essential datum that I have undertaken to write this chapter.

Commander-in-Chief Not to be Interfered With During War.

We have there seen an admirable chief, full of energy and of wise resolution, having a very clear sense of the fundamental rules of the conduct of war and capable, surely, as he has proved himself, of accomplishing great deeds, if the blundering control of an authority exercised from thousands of miles away had not neutralized these incomparable qualities. Quite like Tourville before him, Courbet suffered from too heavy fetters placed by the government on his military actions.

In striking contrast to this is what will happen ten years later in the same theater. We shall not find then, at the head of the Japanese fleets, admirals of such exceptional worth as to deserve immortality, but on the other hand we shall see a staff already conscious of the impossibility of military improvisations, knowing what it wishes and with a firm will to attain to it, having prepared a plan of operations in conformity with sane principles and carrying it out to the end without weakness. We had "the man," but we neglected preparations for war, as well as war itself; in the contest between China and Japan, the conquerors did not have "the man," but they know how to prepare methodically for war and to carry on war. This

was an experimental proof that the system to which von Moltke owed his successes in 1870 is as excellent on the sea as on shore.

One other observation is necessary; there are no profitable operations possible in a war the details of which the political power pretends to direct, when the distance of the field of action forbids its determining their relative importance and following their progress.

We have already had occasion to exhibit the productive freedom of action which Nelson of good rights enjoyed, the elasticity of the general orders given to him, wholly contained in the brief and clear formula; to win command of the Mediterranean, which permitted him to follow the enemy's fleet even to the Antilles.

Suffren, he also felt the full value of military independence when he wrote the minister, de Castries: "The king can be well served in these far-off countries only when those in command have great powers and the courage to use them."

Moreover, our illustrious seaman had found a man capable of understanding him in this minister who wrote to him: "The king has announced to you in your instructions, Sir, that all courageous acts which his generals may do, even though they fail of the success which their boldness deserves, will be none the less honored of him, and that inaction is the only thing with which he will be displeased."

I have already affirmed under too many circumstances the necessity of building everything upon a system of definite responsibilities for anyone to suppose that I am defending the delegation of powers. It belongs to the national authorities alone to give the initial impulse, to establish what may be called the program of future hostilities, but if one makes war, of his own accord or because he is forced to, it matters not which, he must know how to make it; once the war has begun, its direction belongs to the military chief. Every other method leads straight to defeat, and if all the conquests of modern progress in the matter of rapidity of communications are to have for a consequence restraint of the indispensable initiative of the supreme commander in the field, all the benefits which they confer will not be sufficient to make up for their evil effects.

That is why I could not let slip the chance of expressing myself frankly on this subject. If there be need of supporting the examples of Suffren and Nelson, we have the great authority of Napoleon, the master of the subject. Treating, in his Memoirs, of the duties of generals, he expresses himself as follows:

"A general-in-chief is not relieved of responsibility by an order from a minister or a prince far from the field of operations and knowing badly or not knowing at all the last state of affairs: (1) Every general-in-chief who undertakes to execute a plan which he thinks bad or injurious is criminal; he ought to make representations, to insist upon a change, finally to resign rather than be the instrument of the ruin of his own people; (2) every general-in-chief, who, in consequence of orders from a superior, delivers battle with a certainty of losing it, is equally criminal; (3) a general-in-chief is the first officer of the military hierarchy. The minister, the prince give directions to which he must conform in his soul and conscience; but these directions are never military orders and do not exact a blind obedi-

ence; (4) even a military order is to be blindly obeyed only when it is given by a superior who, being on the spot at the moment of giving it, knows the state of affairs. . . ."

It seems to me well to give these quotations, not only because, with due regard for the proportions of course, they apply to the campaign we have just been considering, but also because they condemn the unfortunate natural tendency of the central authority, in almost all contemporary wars, in all countries, to meddle with the practical conduct of operations. I am inclined to think, for my part, that the repeated defeats of General Kuropatkin, on the plains of Manchuria, had no other original cause.

CAPTAIN BELLATI DI SAINT PIERRE, ITALIAN NAVY.

"NAUTICAE RES."

When, owing to the unpreparedness of the naval forces, a commander-in-chief fails in his designs, there is a tendency to make of him a scape-goat. There are thus forgotten the duties incumbent upon governments, and through them upon the nation, in that they failed to give him the necessary and sufficient means for the object that it was determined to secure. The authority of the commander-in-chief is thus halved from the very beginning. Torrington had the scorn of his own country on account of the defeat at Beachy Head, but it would be unjust not to remember that a year previously he resigned as head of the administration, because the government refused his requests to reenforce the fleet which he believed unequal to confronting the events that were preparing. In fact he was absolved by the court martial.

We have already said that it is certainly not advisable for a commander-in-chief to disobey the orders that he receives; but if the situation on the spot makes it evident that obedience may lead to a failure or to a grave error, it is obligatory upon the commander-in-chief to go ahead with his plans without executing the orders that he receives, assuming the entire responsibility for his acts. Such characters are difficult to find, and for this reason—we cannot too much insist upon it—commanders-in-chief must be men of conspicuous moral and military virtue, and of exceptional character. It must be the study of governments to know how to single them out wherever they may be found. In 1866 the man designated should have been Galli della Mantica (allowed to go into anticipated and voluntary retirement) giving no attention to seniority, even as the English selected Nelson; the Japanese, Togo; the Austrians, Tegethoff, Trafalgar, Tsushima, Lissa; what results!

In every war plan the understanding between the army and the navy must be provided for long beforehand, and their respective tasks exactly defined. For this reason, with word and pen, we have always maintained that this understanding should be full and complete.

We should exceed the modest limits that we have imposed upon ourselves in this paper, if we should set forth our ideas in this connection. Let it suffice to say that we maintain the necessity of constituting a permanent Board of Defense, with the express purpose of getting together the energies and the intelligence of the military and naval authorities for the study of

coordinated preparation for war on land and on sea. We content ourselves with referring the readers who desire to go deeply into the question to Lord Esher's work, "National Strategy."

The lack of full and entire understanding between them was the reason for the want of unity between the military and naval authorities at Port Arthur, and the principal cause of the incomplete defense of that fortress. Such a state of things is the cause of interminable delays that redound to the detriment of the defense of the country.

War must have a single direction, and, in the particular case under consideration, a maritime fortress must be under a single command. Let it be naval or military as may be desired this is a matter of no importance, and we do not wish to consider it here; the essential thing is that a single authority shall command, and that the naval and military divisions shall obey. To do otherwise is to court failure, and perhaps also the dishonor of a hasty surrender without having first developed all the means of defense, as happened at Port Arthur. It avails nothing to say that the result could have been different; the essential thing is that the military honor be unspotted.

The proceedings for the surrender of Port Arthur marked a painful page in the military history of Russia, and the lesson is being pondered.

HAMLEY'S

OPERATION OF WAR.

Demanding, then, as this question does, diplomatic as well as military sagacity, it will be most effectually solved when the chief of the state combines the characters of ruler and soldier; and it is not the least of the advantages which a military autocrat, like Frederick or Napoleon, possesses in war, that all the circumstances are apprehended by a single mind, and the decision has all the force and coherence which unity imparts. But when generals are commissioned by their governments to execute warlike enterprises, the questions which depend chiefly on diplomacy must of necessity be solved by statesmen, who, having thus given to the campaign its original impulse and direction, will do well to leave the formation and execution of the military plan in the hands of the general. In practice, however, it is often difficult to reconcile military with political considerations. Thus in 1866 the success of von Moltke's plan was seriously endangered by the delay which was forced on him, for political reasons, by the Prussian Government. In 1870 the disaster of Sedan was caused by the French Government insisting, for political reasons, on MacMahon's movement towards Metz. In war ultimate political success must depend on military success, and the policy which insists on unsound military measures is likely to defeat its own ends. On the other hand, in framing a plan of campaign a general must make full allowance for political exigencies. The failure of McClellan's operations in 1862 is a warning of the danger a general incurs when he attempts to carry out a plan to which his government accords only a half-hearted support.

DOCTRINE OF NATIONAL DEFENSE.

Translation from "Entre l'Allemagne et l'Angleterre," by Captain P. Sorb, French Navy.

"For the third time I recall the principle enunciated by President Roosevelt. In dealing with our foreign policies and, in general, with the attitude which must be maintained by a great nation in the world, it is absolutely necessary to consider first the army and the navy.

"For the application of this principle it is indispensable that the authority charged with the control of our foreign policies have a perfect understanding of the capacity of the army and of the navy. The progress of our foreign policy must be governed by the worth of our naval and military resources. We are not free to choose 'a priori' our friends and adversaries on the day when these compel us to engage in war; we must know if these are such as to assure to us the elements of success or defeat.

"It is not at the moment of strained diplomatic relations that the President of the Council and the Minister of Foreign Affairs should call on the general-in-chief and on the commanders-in-chief of our naval forces to ascertain from them if they are ready to act in the event of such and such a contingency. In a methodical and continuous manner must the government be kept informed of the exact status of the army and of the fleet, since these are the two essential factors to be considered in maintaining our foreign relations.

"The necessity is therefore evident for the intimate coordination between the directing organs of foreign relations and army and navy. Confronted by foreign powers, we must not embark on new ventures, engage in new negotiations without having beforehand carefully considered all the military consequences of a new policy, and without having looked carefully into what we actually shall be able to do, either alone, or with the aid of allied forces. If the projected combination will lead us some day into armed conflict, the Minister of Foreign Affairs must consult the competent authorities of the army and of the navy in order that they may examine together new 'concrete cases' which they may be led to consider, after which, he can arrive at a decision fully cognizant of his course of action.

"In thus dealing with this matter we will avoid dangerous combinations and the possibility of being some day forced to the dire necessity of making concessions and of taking retrograde steps which tend to lower our self respect, and be detrimental to our interests and to our standing among the nations of the world. But, before establishing this bond between the diplomatic authorities and those of national defense, we must first assure ourselves of cooperation between the last, that is to say, between the army and the navy."

CHARLES À COURT REPINGTON.

Military Correspondent of London Times.

"THE FOUNDATIONS OF REFORM," P. 180.

Every one will agree that heads of departments cannot be permitted to wage war on their own account, even with the aid of their expert advisers, without reference to the proceedings of their colleagues. There must be

a point of union, and from this point the central impulsion must derive and extend downward over the action of every department to the extreme confines of the uttermost possession of the crown. This central point must be the Cabinet, because it is the depository of power in a constitutional monarchy. The advisory council of the Cabinet in affairs relating to war is the Committee of Imperial Defense. *This is the Prime Minister's committee*, and though it has a semi-permanent composition, he calls to it whom he pleases, many or few. When it is assembled in full strength it is practically a committee of the Cabinet strengthened by expert official advisers. It is then the lineal descendant of the Secret War Council over which Pitt rather dominated than presided. If war is to remain an act of government it is from the council-room in Whitehall Gardens that all initiative in war must emanate, and by this committee that every proceeding of a war must remain controlled, so far as it lies in the power of one side to control a game in which there are two players.

The committee combines knowledge with power, but owing to the autocratic powers which strong ministers occasionally arrogate to themselves, the fact will not necessarily result in unity of direction and coordination of all effort to a single end unless steps are taken in advance to secure these advantages. It is better that we should regulate in advance, and in a manner stereotype, principles for the direction and control by the committee of all concerns of war than arrive painfully at the same end in the midst of a war after shedding recalcitrant ministers and upsetting, as in 1757, the entire machinery of government. We therefore require that there should be embodied in a state paper and accepted by every minister on assuming office, the principles by virtue of which every department of government shall obey without question or delay the directions of the Defense Committee the instant war is imminent or occurs, and whereby the centralized control of events shall be absolutely, uninterruptedly, and efficiently maintained.

No one would desire or propose that the committee should interfere with the administration of army or navy, should concern itself with the operations of armies or fleets, or should attempt to diminish by one iota the initiative and independence of commanders. Pitt never attempted to do that. What Pitt did, and what the committee must do, is to define clearly the objects in view, to secure the provision of forces adequate for the purpose, and then to leave to commanders unfettered liberty of action within the limits of their particular missions, and to departments the express duty of supporting these commanders with all the resources at their disposal.

Even if the general plan of the campaign established by the Defense Committee is not exactly brilliant, it is better for the country to pursue an ordinary plan with unanimity and vigor than to allow dispersion of effort and war by fits and starts which would infallibly result from warfare by departments. If the army has its plans, the navy its plans, and other departments their several and separate objectives, nothing but confusion and disaster can be expected. If the navy suddenly asks for 20,000 troops before the army is mobilized, or the army for convoy which cannot be provided, we should soon be in a parlous plight. It is imperative that every initiative

in the largest sense should come from the committee, which can alone be in a position to maintain a clear, impartial, and uninterrupted view of the whole world-wide theater of a war.

Many other departments besides the Admiralty and the War Office will be concerned in a great war, notably the Exchequer, the Foreign, Colonial, and Indian offices, and the Board of Trade. The mission of each one of these departments should be defined in advance to meet the case of at least one great war, which may not prove to be a remote contingency. The work of one of these departments—namely, the Foreign Office—is distinct from that of others, since it is more by preparation of the ground before war breaks out than by activity afterwards that it can, as a rule, render the greatest services.

BISMARCK.

THE MAN AND THE STATESMAN.

II.

If the theory which the staff urged against me, and which is said to be taught as part of military science, can be expressed by saying that the Minister of Foreign Affairs comes again to the fore only when the commanders of the army find that the time has arrived for closing the temple of Janus, surely the double face of Janus conveys the warning that the government of a state engaged in war must look in more directions than towards the scene of the struggle only. The task of the commanders of the army is to annihilate the hostile forces; the object of war is to conquer peace under conditions which are conformable to the policy pursued by the state. To fix and limit the objects to be attained by the war, and to advise the monarch in respect to them is and remains during the war just as before it a political function, and the manner in which these questions are solved cannot be without influence on the method of conducting the war. The ways and means of the latter will always depend upon whether the result finally obtained is the one desired, or more or less; whether cessions of territory are to be demanded or forborne, and whether temporary occupation is required, and for how long.

Still more difficult in the same line is it to judge whether and with what motives other powers might be inclined to assist the adversary, in the first instance diplomatically, and eventually by armed force; what prospect the representatives of such a combination have of obtaining their object in foreign courts; how the parties would group themselves if it came to conferences or to a congress; and whether there is danger of further wars being developed from the intervention of neutrals. But above all is the difficulty of deciding when the right moment has come for introducing the transition from war to peace; for this purpose are needed knowledge of the European conditions, *which is not apt to be familiar to the military element, and information which cannot be accessible to it.* The negotiations at Nikolsburg in 1866 show that the questions of war or peace always belong, even in war, to the responsible political minister, and cannot be decided by the technical military leaders. But the minister concerned can only give the king expert advice, if he possesses a knowledge of the actual position at any moment and of the views of those who conduct the war.

(*London Times*, January 11, 1912.)

THE NAVAL WAR STAFF.

DEVELOPMENT OF THE SCHEME. EVOLUTION NOT REVOLUTION.

(*By our Correspondent for Naval Affairs.*)

Not the least of the merits—which have been generally acknowledged—of the scheme for the constitution of a War Staff for the navy promulgated on Monday by Mr. Winston Churchill is that it is essentially an evolution and not a revolution. It leaves unimpaired the powers, statutory and prescriptive, of the Board of Admiralty, and it seeks to provide it with a well-organized thinking department by development and not by reconstruction. The Admiralty is one of the oldest institutions of the state. It has a long and eventful history—a history which goes much further back than that of any of the instruments which authorize without exhaustively defining, and thereby circumscribing, the due exercise of its very multifarious functions, and the dominant fact in this history is that, in spite of many and grievous shortcomings, it has conducted naval war in the past with unexampled success. "The more I have investigated the matter," said Sir James Graham in 1861, "the more I am satisfied that, like the Common Law in aid of the Statute Law, the power exercised by the Board of Admiralty and the different members of it rests more upon usage than upon the Patents, uninterrupted usage from a very early period." To such an institution, so immemorial and withal so flexible in its usages, so illustrious in its achievements, the method of development is manifestly more appropriate than that of reconstruction. A War Staff for the navy should, therefore, be a new organ, spontaneously evolved from within rather than something imported and grafted on from without. I would define it as a necessary extension of the mind of the Board, and especially of the First Sea Lord.

THE FIRST SEA LORD AND THE STAFF.

By the Order in Council of August 10, 1904, the several Sea Lords were "to be responsible to the First Lord of the Admiralty for the administration of so much of the general business connected with His Majesty's Navy and with the movement and condition of His Majecty's Fleet and with the personnel of that fleet as shall be assigned to them or each of them from time to time by the First Lord." Under this Order in Council a scheme for the distribution of business was promulgated by the then First Lord, Lord Selborne, on October 20, 1904. The business assigned to the First Sea Lord by this instrument was in general terms "organization for war and distribution of the fleet." More specifically this business was distributed under three heads—"1. Preparation for war: All large questions of naval policy and marine warfare—to advise. 2. The fighting and sea-going efficiency of the fleet, its organization and mobilization; the distribution and movements of all ships in commission or in fleet reserve. 3. The control of the Intelligence, Hydrographical, and Naval Ordnance Departments." Having regard to the executive, as apart from the administrative functions here assigned to the First Sea Lord, it is plain that, as Mr. Churchill points out in his memorandum, that officer "occupies for certain purposes, especially the daily distribution of the fleet, on which the safety

of the country depends, the position of the commander-in-chief of the navy, with the First Lord immediately over him as the delegate of the crown in exercising supreme executive power." Now, inasmuch as every commander-in-chief afloat is provided with a staff charged with the duty of working out in detail his orders and plans, and with the clerical formulation of his orders necessary to give them due executive effect, it follows by parity, not to say by cumulation, of reasoning that in so far as the First Lord is a commander-in-chief, he must have a similar staff, more highly organized in its structure and more extensive in the scope of its operations if he is efficiently to discharge the supremely responsible duties imposed upon him—and this all the more because in addition to the executive duties of the commander-in-chief he is also charged with administrative duties of great moment and pressure. The same reasoning points with equal cogency to the necessity of providing him with a chief of the staff whose special duty it must be to coordinate and bring to a focus all the business of the staff for his final consideration and decision.

THE INTELLIGENCE DEPARTMENT AND ITS EVOLUTION.

All this has long been recognized in a certain sense, and the Intelligence Department, first established more than 20 years ago and subdivided more than two years ago into an Intelligence Department proper and a Mobilization Department, was the first embodiment at the Admiralty of the idea of a War Staff. In an inchoate form the Intelligence Department became the staff of the First Sea Lord and its director was his chief of the staff. But with the progressive increase of the fleet the business of collecting war information, of preparing war plans, and of formulating war arrangements has grown far beyond the capacity of a single officer directing a single department to transact with due efficiency and despatch. What has been done now is to add another division of supreme and almost incalculable importance, the Operation Division, to the two divisions of Intelligence and Mobilization already existing; and since the business of these three divisions is all intimately and organically correlated and the directors of each are to be coequal in rank and authority, the analogy of sea command is again to be called in aid, and a chief of the staff is appointed to collect into a single strand all the threads of business issuing from the several divisions.

THE OPERATIONS DIVISION.

The separate constitution of the Operations Division may well be regarded as the crowning of the whole edifice. In the due coordination of war information, war plans, and war arrangements, the whole art of war may be said to consist. The information must be the most accurate and exhaustive that intelligence and industry trained in its pursuit can obtain; the plans must be the most sagacious that the highest and most instructed strategic insight can devise; the arrangement must be the best that can be made for the effective prosecution of the plans so devised. Of these the plans are by far the most important, and require the largest measure of trained intelligence for their preparation. At the same time, it is necessary

to give due heed to a passage in Mr. Churchill's memorandum which has not as yet received much attention:

"Although the methodical treatment of the vast number of subjects to be dealt with by the staff requires that there should be divisions and subdivisions, yet it is imperative that these should never be permitted to develop into "watertight" compartments. It will be found that there is so much overlapping between divisions that a constant, free and informal intercourse between them is indispensable. To promote this the chief of the staff will be enjoined to hold frequent meetings to be called 'staff meetings,' with the heads of the three divisions, and each of the directors will be kept fully acquainted with the work of their two colleagues. Each one of the directors will be ready at any moment to act for the chief of the staff in the latter's absence from whatever cause."

This is perhaps the explanation of the otherwise rather questionable provision that "the chief of the staff will not be the sole channel of communication between the First Sea Lord and the staff; and the First Lord and the First Sea Lord will, whenever convenient, consult the directors of the various divisions or other officers if required." Some misgiving has already been expressed by the *Times* in regard to the working of this provision. If the Admiralty were not a department *sui generis*, instinct with that spirit of give-and-take and mutual cooperation which is needed to the sea service, I should share that misgiving. But in Admiralty administration the spirit is everything, while the letter counts for very little in comparison and I am confident that in this case, too, the spirit will prevail over the letter, more especially as, like the sea itself, the staff is to be "all one."

ADMIRALTY AND WAR OFFICE.

"It is necessary," said Mr. Churchill, "that there should be a close and whole-hearted cooperation between the War Staff at the Admiralty and the General Staff of the army." That might be regarded as a self-evident proposition, were it not notoriously the fact that the relations between the Admiralty and War Office have often been of that "watertight compartment" character which Mr. Churchill so justly deprecates in respect of the several divisions of the Naval War Staff. There are many problems of war which concern the navy and army in common; indeed, it might almost be said that there are not very many which directly or indirectly do not. Yet it is also notorious that the solutions of these problems which have commended themselves to the Admiralty have often proved very far from acceptable to the War Office. How far a closer and more whole-hearted cooperation between the staffs of these two departments may tend to resolve these antinomies in the future experience alone can determine. It may be conjectured that when staff meets staff then indeed will come the tug of war; and for the reconciliation of those fundamental divergences which, as Mr. Balfour pointed out in 1905, have existed almost from time immemorial between different schools of naval and military thought, we may, perhaps, look as Lord Haldane seems to look, to another and higher authority than any which resides either in the War Office or in the Admiralty. Speaking at Edinburgh on Monday, Lord Haldane said:

"The Navy had now got, like the Army, a General Staff. The Navy and the Army were now going to cooperate in this problem of defense in a fashion they never did before. They had now got the two brains of the two Services thinking out these war plans . . . . thinking out the great coordination of the Army and the Navy. These two staffs had above them a yet more General Staff in the Defense Committee."

It is in this direction that almost certainly lies the true solution of the problem which some people thought might be solved by the appointment of a Minister of Defense supreme over both War Office and Admiralty. *The only possible Minister of Defense of this character in this country is the Prime Minister,* who is, by the prescriptions and usages of the Constitution, supreme over all departments in respect of all high matters of policy. The Committee of Imperial Defense is the General Staff of the Prime Minister in his capacity as the ultimate Minister of Defense—an extension of his mind in so far as it is applied to the higher problems of defense. If the Admiralty and the War Office differ and cannot be brought into agreement by the agency of their respective staffs their differences must be brought to the Prime Minister and finally decided by him in the light of exhaustive discussion at the Committee of Imperial Defense. The creation of the War Staff at the Admiralty will enable the two departments to meet on equal terms in their joint deliberations. But it will not necessarily establish harmony between them, since each is coequal with the other in his own sphere of activity. That can only be done in the last resort by the agency and procedure just indicated.

TRAINING FOR THE WAR STAFF.

It is significant of much that the creation of a War Staff for the Navy and the emergence of an Operations Division as an organic element in its evolution should synchronize with a recognition by the Admiralty of the urgent need for a special course of training for the officers who are to serve on the War Staff of the future. Hitherto Staff officers in the Navy have had to learn their duties according to the method prescribed by Mr. Squeers, namely, by doing them. Henceforth they will first be taught how to do them. Mr. Churchill enunciates two most excellent principles which are to be regarded as paramount in the constitution of the Staff College—for so we may call it though it is not so designated in the memorandum, being there rather regarded as an internal development of the already existing War College—now to be provided for the navy. First the personnel of the War Staff . . . . will consist of naval officers fresh from the sea and returning to the sea fairly frequently." That is a condition quite indispensable to the efficiency of such a service as the navy. The higher leading in naval war must never be divorced from direct and frequent contact with the sea.

Secondly, nothing in the constitution of the staff will be designed to arrest the free play of professional opinion in all its members from top to bottom. Fresh ideas, new suggestions bred by independent study and reflection may find their proper expression in all ranks. Disciplined cooperation in working out schemes which have been prescribed will not exclude reasoned

criticism and original conceptions, the central objects being to form at once a convenient and flexible machine for the elaboration of plans and a school of sound and progressive thought on naval science.

All this is quite admirable. The Staff College and War Staff emerging from it must never be a school of unchanging dogma. It must be an agency for the cultivation and dissemination of living and progressive thought. It is to think and not to act. It will in no way control or fetter the mind of the First Sea Lord and others, who are to act, it may be, on its inspiration, but on their own sole responsibility; but it will inform it and thereby fortify its executive decisions with all the authority to be derived from sustained thought based upon exhaustive information. It must never be allowed to usurp any of the functions and responsibilities proper to the Board of Admiralty or to any of its members. But there can be little doubt that in course of time its influence, direct and indirect, will prove to be the little leaven that leaveneth the whole lump. After all, the brain is the directing member of the organism.

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THE RELATIVE IMPORTANCE OF TURRET AND TELESCOPE SIGHT.

By REAR-ADMIRAL BRADLEY A. FISKE, U. S. Navy.

The value of the turret is recognized. The victory of the *Monitor* over the *Merrimac* was so opportune and dramatic, and its results were so evident, important and immediate, that the turret was at once proclaimed, by all the world, to be one of the greatest inventions of the age.

The telescope sight, on the other hand, made its obscure little début on a small gun-boat, way up in Bering Sea; its value was not realized for ten years; and it grew so slowly into use that it came gradually to be regarded as a "matter of course." Though adopted now by every civilized navy in the world, it has nevertheless received no individual recognition; and yet there are some who think that it is a more important factor in naval warfare than the turret.

To compare the relative values of the turret and the telescope sight, let us imagine two ships, *A* and *B*, meeting on the ocean and fighting; *A* having open sights and turrets, and *B* having telescope sights and no turrets, *B's* guns being arranged in broadside.

Which ship would whip?

A would be able to fire, say, ten guns on a broadside, and *B* only five. As to firing ahead or astern, *B's* guns would probably be disposed according to the old-time plan, with the forward and the after guns on two different decks, so that she would be able to fire four guns ahead and four astern, the same as *A*.

Of course, the proper tactical utilization of greater accuracy of gun fire would dictate that *B* should keep at a very long range and not present a long target laterally, so that *B* should keep *A* on his bow or quarter as far as practicable. But in order to make our comparison applicable to a fleet action, we have to assume that

both ships turn their broadsides to each other, and engage at some moderate distance, say 10,000 yards. In this case, *A could* fire twice as many guns per minute as *B;* so that, if the accuracy were the same in the two ships, *A* would probably hit *B* twice as often as *B* would hit *A*.

But the accuracy would not be the same. It is impossible to state exactly what the ratio of accuracy would be; but it certainly would not be unfair to the open sight, if we accepted the same ratio as characterized the performance of the two sights on the only occasion when their value could be compared under identical conditions. This was the first time the telescope sight was ever tried. It was on board the *Yorktown* at Unalaska, on September 12, 1892. A diagram of the firing is here shown.

If anyone will take the trouble to measure off the vertical deviations of the two series of shots, he will find that the mean vertical deviation of the shots fired with the open sight was 6.54 feet, and with the telescope sight 2.25 feet, the ratio being as 2.91 to 1. This is on the supposition that the five shots fired with the open sight, and which could not be plotted on the diagram (which extends 15.75 feet above the mean point of impact), had a mean vertical deviation of 15.75 feet. If he will also measure the mean lateral deviations of both series of shots, he will find that they are 8.90 feet and 2.75 feet respectively, the ratio being as 3.23 to 1.

It is not here claimed that the shots were plotted with mathematical accuracy, but that they were plotted with a sufficient approximation to accuracy to form a fair basis of comparison, and as accurately as the appliances of that day permitted. The fact that the fourth shot brought down the target in a mass on the raft, and that the target was found to have three holes in it when examined, indicates that the shots fired with the telescope sight are quite accurately plotted.

The fact that the last shot, fired with the telescope sight (No. 23), was fired at the vague mass of wreckage, and therefore ought not to be counted, is here ignored.

Certainly it could not be objected with reason that the ratio, 2.91 to 1, is unjust to the open sight. The great accuracy of naval gunnery to-day, as compared with its accuracy before the invention of the naval telescope sight, indicates a much larger ratio than 2.91 to 1; and this larger ratio cannot be due to im-

proved methods of drill and training, or to the effect of spotting and fire control; because, while these things increase the rapidity and the effectiveness of the fire of a group of guns, they do not and cannot increase the accuracy of the fire of any individual gun beyond its own inherent accuracy. They simply utilize that accuracy.

Suppose *A* and *B* approach to a distance of 10,000 yards and begin to fire. It is clear that the vertical target presented by each ship would be about 30 feet, and the mean vertical deviations of *A* and *B* about 49.5 and 17.03 feet respectively; so that, referring to page 129 of Alger's Exterior Ballistics, we see that the respective probabilities of hitting, in the case of each gun in the respective ships, would be in the ratio of about 2.71 to 1 in favor of *B*, supposing both ships to have their mean points of impact on the centers of their respective targets, a supposition not unjust to the open sight.

The veritical deviations, 49.5 and 17.03 feet mentioned above, are based on the assumption that if the deviations with the open sight and the telescope sight were 6.54 feet and 2.25 feet respectively at 1320 yards, both deviations would be increased in the ratio 10000/1320 at 10,000 yards. But both would really be increased more than this, because not only does the deviation, with a clear target, increase as the range, but the target becomes dimmer, thereby causing increase of deviation; and this increase of deviation would be greater with the open sight than with the telescope sight, for the reason that the telescope clears up the target and gives a definite point of aim.

The figures 49.5 and 17.03, therefore, are not unfair to the open sight, but the reverse.

By reason of the great lateral targets presented by the ships relatively to the mean lateral deviations of the guns, the superior lateral accuracy due to the telescope sight would have little weight, and it is therefore ignored here.

It is impossible to reason out which ship would begin to fire first. So it must be assumed that they would begin at the same time.

B, of course, would use salvo firing. Whether *A* would or would not use salvo firing, it is impossible to say; but it is safe to say that he would do better by not attempting it. Previous to the introduction of the naval telescope sight, salvo firing with open

gun sights had been found extremely inaccurate and was only used at very short ranges. Some ships, especially in the British Navy, were fitted for salvo firing, but by electricity and from a "directing station," where the officer who fired the battery, used a telescope for sighting.

It seems sure that *A's* fire per gun would not be so rapid as *B's*. *B* could fire her five broadside guns in salvo once in 30 seconds. But with the open sight, where the main difficulty was in getting the pupil of the eye exactly on the line joining front and rear sights at the same time the line of sight was on the target, a "gun-captain" had frequently to wait a long time after his gun was loaded before he could get "a good sight." It must be remembered that it was necessary for him to have his pupil on the line of sight not only in the vertical plane, but also in the horizontal plane; and that if he lost his chance at the end of one roll he would have to wait until another roll came along. Besides this, *A's* firing would undoubtedly be handicapped by the smoke of one gun interfering with another gun, and, in the case of any single turret, by the fact that one gun would have to wait until the jar caused by the other gun had subsided.

Bearing in mind the fact that the firing on board the *Yorktown* was done at anchor in smooth water and at an anchored target, when it was comparatively easy to keep the pupil of the eye on the line of sight, so that the conditions were much more favorable to the open sight, as compared with the telescope sight, than would obtain under ordinary conditions on board a ship under way at sea, firing at a moving target, it would seem that, in order to attain the relative accuracy of fire between *A* and *B*, which was found on board the *Yorktown*, the rate of fire per gun of *A* would have to be extremely deliberate; certainly not greater than one shot per gun per minute, about one half of that of *B's* guns. That is, the number of guns fired per minute on board the two ships would be about the same.

This means that the hits per gun per minute would be as 2.71 to 1, in favor of *B*, supposing that both ships got their mean points of impact on their respective targets at the same instant, and supposing also that there is no cumulative effect in an "initial advantage."

But they would not get on their targets at the same instant and there is a cumulative effect in the "initial advantage."

B's spotter, after one or two ranging shots, would probably straddle the target with his first or second salvo, and in about a minute after the first ranging shot would begin to land 25% of hits on *A;* that it, 2½-12 inch shots per minute.

It is highly improbable that *A* could get his mean point on *B* by this time. His task would be extremely difficult. Not only would he have a large dispersion in range to deal with, but, as the projectiles would not fall into the water together but separately, and at irregular intervals of time, his calculations as to how much to raise or lower would be complicated by the necessity of remembering how the various shots fired with a certain sight bar range had fallen; and it would be practically impossible to even ascertain this after he had raised or lowered once, because he would not know whether the last shots had been fired with the last range he sent down, or the previous one. His difficulties would be increased too—compared with those of *B's* spotter—by the larger lateral dispersion.

All these difficulties would increase after *B* began to hit; and then the people in the turrets, conning tower and elsewhere would begin to have their troubles. These troubles would increase, and would cause confusion, and would progressively augment *B's* initial advantage; so that it is possible that *A* might be defeated without ever getting his mean point of impact on *B* at all.

But let it be imagined that both ships get on their targets at the same instant, and that *B's* only advantage is the relative probability in h. p. g. p. m. of 2.71 to 1 in *B's* favor.

The only advantage which *A* would have to oppose to this offensive advantage would be the defensive advantage due to the superior protection given by her turrets; and this would simply be due to the fact that the ports through which *B's* gun would have to fire, in order that the guns might have a sufficient train, would be much wider than the ports in *A's* turrets. But the width of *B's* ports perpendicular to the line of fire would not be greater than the inside diameter of *A's* turrets; that is, about three times the width of *A's* ports; and the lateral target of even a whole turret is so small, relatively to the mean lateral deviation of the gun, that the superior probability of hitting laterally attained with the telescope sight (ratio about 3.11 to 1, assuming the data of trial on board *Yorktown*) would have to be taken into account; so that the probability of hitting a turret or any-

thing of similar dimensions would be, not as 2.71 to 1, but as 2.71 x 3.11 to 1, equal to 8.43 to 1, in favor of *B*.

Therefore, the greater width of *B's* gun ports would be more than counterbalanced by the greater probability that *A's* ports, or the guns in them, would be hit; and the probability of a shot entering a port *or* striking a gun would be about as 8.43 to 3 in favor of *B*.

The probability of striking a gun would, of course, be about 8.43 to 1, in favor of *B*.

It will be noted that no account is taken here of the fact that the turret itself, or the armor in front of and over the broadside gun, is not really invulnerable; and that, even if it were, the shock of receiving a 12" shell would be very detrimental to the personnel and material behind.

There would still remain, therefore, the original probability of 2.71 to 1 in favor of *B*, an advantage nearly equal to the advantage that three sister ships would have over one other sister ship.

Of course, the ratio of probabilities would really be much greater than this, but to a degree that eludes computation. This ratio of 2.71 to 1 takes account merely of the probability of hitting the areas exposed by the entire ships as targets. It disregards entirely the advantage *B* would have in his ability to use salvo firing, the cumulative effect of "the initial advantage," which *B* would get at the start, and the advantage *B* would have in being able to direct his fire at will on individual parts, such as the conning tower. It also neglects the fact that the probability of hitting the conning tower would be about as 8.43 to 1 in favor of *B*.

It would seem then that *B* would whip *A*, and quickly.

We have thus far limited our comparison to gunnery warfare. But there is another very important field of naval warfare, and that is torpedo warfare.

So let us suppose that *A* and *B* are attacked by destroyers, in the daytime. At night, the telescope sight has an unquestionable advantage, but it is small.

As the destroyers would head towards their respective target ships, the lateral targets presented to those ships would be so small that the smaller lateral deviation due to the telescope sight would have to be taken into account, as well as the the smaller vertical deviation; so that the probability of hitting the area

presented by a destroyer would be about 8.43 times as great with the telescope sight as with the open sight.

This means that, with a given degree of risk, one group of destroyers would have to keep nearly three times as far from *B* as the other destroyers from *A;* and that *B's* chances would be 8.43 times as good as *A's*.

It also means that, if we did not have the telescope sight, destroyers, without taking a greater risk than at present, could approach battleships by day to nearly one-third of the distance which they must now observe; that is, close to the distance at which their torpedoes are effective. In this case, it might be a serious question whether it were worth while to build battleships at all. Certainly it would be a serious question with the Congressmen who appropriate the money.

The destroyer has been gaining rapidly in seaworthiness and speed, and the torpedo itself in accuracy and range. The destroyer has been menacing and is menacing the very existence of the battleship, not only in war, but also in peace; for the strongest argument against appropriating money for battleships is the torpedo. The only thing that keeps away the destroyer is the gun; and a group of destroyers could approach a battleship, and fire torpedoes at her, with considerable chances of success, at 4,000 yards in the daytime, if they were not fired at by accurately sighted guns.

But it is not necessary to limit our supposed attack to destroyers. Let us suppose that *A* and *B* are attacked by fast cruisers, whose machinery and torpedoes would be below the water line, so that their degree of immunity from being sunk would be much greater than that of destroyers. Such cruisers, unless in very large numbers, would have no chance whatever against *B;* but an attack of say six against *A* would have a respectable chance of success. How many such vessels would be required to sink *A,* no man can tell; but it is certain that *B* could stand off at least 8.43 times as many as *A* could.

Therefore, it is possible that, were it not for the naval telescope sight, the battleship including the turret might have become obsolete before now. It is certain that battleships would have much less than their present effectiveness to plead as a reason for their existence, that they would fall an easier prey to the torpedo, and that we should have had, and should still have, very much more difficulty in getting money to build them.

The turret has no field of usefulness in torpedo warfare, and is applicable to battleships only. The naval telescope sight has an important field in torpedo warfare, and is applicable to all kinds of vessels. Over the whole world to-day, there is hardly a modern gun on board a modern vessel that is not fitted with telescope sights.

In the war between Japan and Russia, the destruction of the Russian fleet at Tsushima was so complete as to end the war. The main cause of its destruction was that the Russian gunnery was less accurate than the Japanese. The more accurate gunnery of the Japanese secured an initial advantage in the beginning of the battle; and this advantage, according to a natural law, increased in geometrical ratio as the battle went on, and became overwhelming in a few minutes.

It has been stated on excellent authority that the Japanese guns were fitted with telescope sights in good order, while very few of the Russian ships had telescope sights, and that the telescope sights which were fitted were not in good order.

If this be true (and it probably is), the reason for the sudden annihilation of the Russian fleet stands out sharp and clear; and we see that *the naval telescope sight, more than any other one thing, was the cause of the turning of the tide of history in the direction in which it did turn.*

If this be true (and it probably is), the influence of the telescope sight in the Russo-Japanese war was greater than the influence of the turret in our Civil War.

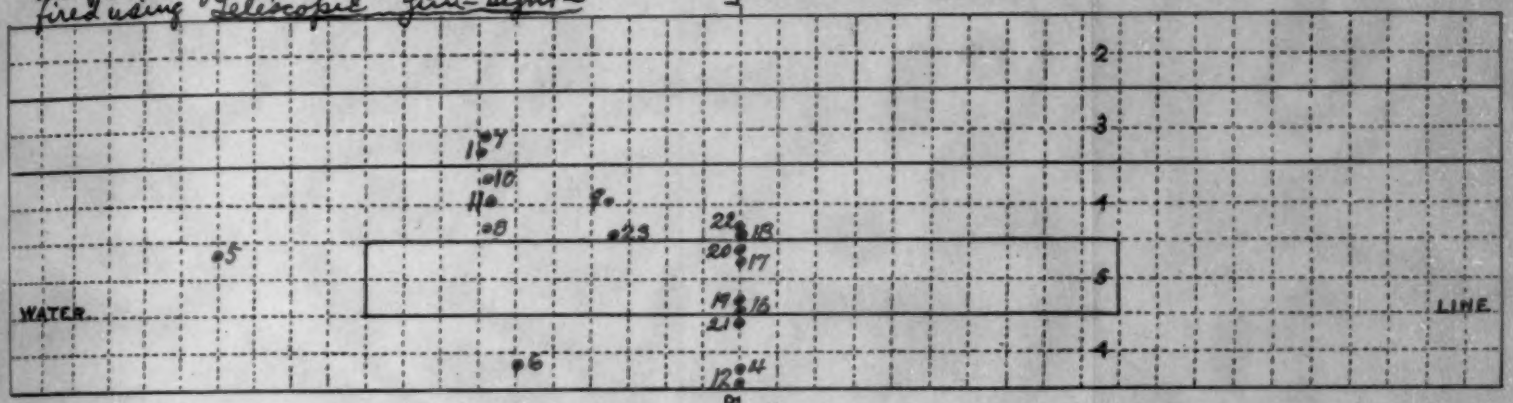
Note
The dots and figures in red indicate the points of impact of projectiles fired, using the ordinary gun-sights = The dots and figures in black indicate the points of impact of projectiles fired using Telescopic gun-sight

VERTICAL TARGET, showing points of impact of 6" projectiles fired, using ordinary gun sights and Telescopic gun sight

Scale, 1 inch = 10 Feet.

ABOVE

Shots 2, 3, 13, 14 and 15 cannot be plotted on this sheet.



Shots 1, 4, 5 and 6 are correctly plotted; shots 2 & 3 can not be plotted on this sheet.

T. E. De Witt Veeder Lieut. in charge 1st Division

Shots 7, 8, 9, 10, 11 and 12 are correctly plotted

B. A. Fiske, Lieut. in charge 2d Division

Shots 16, 17 and 18 are correctly plotted; shots 13, 14 & 15 can not be plotted on this sheet.

A. Whitehalter Lieut in charge 3d Division

Shots 19, 20, 21, 22 and 23, fired using Telescopic Gun-Sight are correctly plotted

B. H. Hutchison Ensign & observer

Shots Fired.	Guns, Number and Class.	Name of Gun Captain	Average Time Between Shots.	Number of Guns Firing	Limits of Range.	Merit On Target.	Final Merit.
	6" B.L.R				Yards 1320		

At Anchor

U.S.S. Yorktown.

Date of Practice, September 12, 1892

Place of Practice: Unalaska, Alaska.

Wind and Weather: Light breeze. Clear.

Smoke: not great at instants of fire.

Rolling and Pitching: 1° each side; pitching imperceptible.

The actual scale of this reproduction is 1 inch = 12 feet.

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NOTES ON THE SWEDISH SYSTEM OF PHYSICAL TRAINING.

By SURGEON J. A. MURPHY, U. S. Navy.

In view of an apparent increasing interest in physical betterment, brought out by executive order bearing on the subject; by realization on the part of many that a good body is necessary to withstand the demands on physique of the present increasing tension of naval life, which can be expected to increase enormously in time of war; and, by such results represented by sickness, medical surveys, early retirement, and in other ways under the broad qualification of decreased efficiency, following the presence of defectives in the personnel; it has been deemed of value to compile and arrange some data on the subject which might be of use to the individual concerned as a manual of physical training.

Physical training in this country as a general institution has, until recently, been confined almost entirely to the athletic variety in which the superior physiques, already superabundantly endowed by nature, engage in activities of various kinds called sports with the ever present idea of outshining someone else in a particular form of effort.

The various sports or games were originally intended as a beneficial means of improving physique so as to fit the subject the better for his future activities in life; through specialization, however, the recreational element and ultimate aim of exercise has been lost sight of, and they no longer serve the purpose. In the desire to win at any cost only those points are considered which tend to this end. Such retrogressive tendencies as have developed have been fostered by stimulated ambition on the part of contestants, by the desire of many institutions for the advertisement success brings, and by a class of men gradually evolved by these conditions whose livelihood depends on turning out winning teams.

These men (coaches, trainers) have at the most an insecure tenure of office and even when properly qualified by knowledge or experience in the use or misuse of the human body, through lack of time can give very little consideration to progressively developing a weaker subject, who invariably soon drops by the wayside, leaving the superior material to be forced to a condition of physical excellence calculated to bring out one or at most several supreme efforts.

In this scheme of development the good or bad effect is centered in a few, and the many have been left to shift for themselves. It is very evident that the forcing process is having its harmful effect not only on the exceptional physiques, but also on those of weaker physique who try to emulate the example of the strong, in many instances apart from observation and advice because of the trainers' concentration of thought on more likely candidates, or by reason of a general emulation, as witnessed by the effect on school children after the Dorando-Hayes marathon race. These near athletes having no athletic history rarely get into the statistics (except as men of non-athletic type) when from time to time proof is offered as to the benefits to be derived from machine athletics.

It is to be noted that statistics, heretofore advanced as a means of proving that certain forms of athletics are not harmful, have been based on those exceptional physiques who were the survival of the fittest in that their names were recorded as stars. The statistics refer only to longevity and the comparison is a general one, all types of non-athletes being taken as examples on the other side of the question. A comparison between the non-athletic, robust man and his athletic fellow would yield different results. In the last report of the Surgeon General, U. S. Navy, the medical records of 625 Naval Academy athletes (covering a period of 20 classes) were looked into, and of this number 21 have died or retired, and 198 show defects referable to their athletic activity, affecting their future efficiency as officers in the Navy. It can be expected that this result will be more suggestive in view of the fact that the earlier athletes worked under less pressure (records not so low) and that the later athletes have not been under observation long enough for constitutional effects to show.

The modern idea of athletics is to make a machine out of the human body and to run this machine to a limit short of producing

an immediate and irreparable smash-up. When it appears that skill is absent, or is equal, the tendency is to make endurance supreme, and when this element enters and is carried too far, it is a common occurrence for individuals to collapse despite exceptional physiques to start with and special preparatory training.

If the condition of preparedness for maximum effort could be made a lasting process it would be justifiable. The onset of a condition known as staleness (a symptom of rebellion on the part of the body) renders this a failure however, and repeated doses of muscle and nerve fatigue soon lessen the individual's usefulness, as is evidenced every day by the rise of new stars, and the brief reign and fading glory of those of yesterday.

In a military organization the general speed and efficiency will come from the bottom, and not from the few superior physiques at the top, and here more than in civil life physical training should be devised to improve the weakest type and maintain the vitality of the individual at a point where, if called on in battle, he can wreck his health to national advantage.

The high tension athletics of the present day can be considered of questionable benefit to the few men engaged as contestants, and to the many who look on as spectators of no benefit whatever. Under the present system it is very difficult to get average individuals to gather together to form a team of some kind for a contest of pleasure and recreation as is the practice of the English.

Any form of physical effort, when too frequently engaged in; too long continued at one time; or, when the individual is forced by his training or by the desire to win, to ignore certain warnings of nature (breathlessness, constricting sense about chest, black specks in vision, dulling of sensation, extreme fatigue, etc.); can be expected to produce harmful results. On the other hand the same exercise when carried out progressively, always within the power of the individual, and short of fatigue or the signs of cumulative strain, cannot be but beneficial, as proved by the different reaction (pleasureable sensations, animation, bright eyes, cheerfulness, and continuous increase in vital power, without the need of careful nursing, diet, etc.).

Realizing the disadvantages of specialized athletics there has been unfolded, in the last few years, an increasing sentiment toward developing the many, who in the end really need consideration, and as a result nearly all the universities and schools in

the country have adopted a more or less effective course of compulsory physical training comprising gymnasium work and athletics. In connection with athletics there is a tendency to restriction by means of limitations of various kinds (medical, strength, and scholarship standards; lessening number and duration of contests; and to prevent constant training, permitting one individual to engage in but two sports each year). More attention is being paid to inter-institutional contests in order to reach those who cannot make the varsity squad, the members of which are barred from inter-class teams.

This year for the first time at the Naval Academy compulsory gymnasium physical training was established for all midshipmen, partly as a result of observation on over 1700 midshipmen of the classes 1900 to 1910 which showed that even including the athletes, first classmen on the average actually decreased in weight and relatively decreased in strength when compared with their second class year. Under the present system of compulsory gymnasium drill for all classes restraint is being enforced in different ways in connection with athletics, the effect being to stimulate a desire for uniform development, and to spread the athletic material into more lines, and to get more men out, and in consequence it is hoped to obtain better results. The gymnasium drills are still insufficient in number, consisting of only one hour weekly for 16 weeks during the four winter months, but those midshipmen found deficient in strength and swimming receive in addition 2½ hours extra drill weekly.

The dynamometer strength test in use at the Naval Academy is the basis for the course in physical training. This test is given to each midshipman in October and April, and serves to classify the individual as strong or weak, besides giving him an idea of his weak and strong points. The test as now given, while coarse in some respects, shows without question the effect of different forms of exercise both as developers, and, in many instances, the effect of over-use in decreasing power.

Gymnasium training as practiced in many places is open to the same objections which apply to athletics, attention in some instances being localized on a few who are taught to excel in doing stunts on the apparatus, and in other instances the effort is made to make the subject feel the exercises, so that many of the class drop out from exhaustion before the completion of the period.

Development, of course, cannot be expected to follow lack of exercise, but it will follow a graded form of exercise, ceasing before the onset of fatigue, not too frequently repeated, and free from the cumulative endurance element. Development will decrease when the exercise is continually carried out to an excessive degree, the condition resulting from the burning up of the muscle tissue, the trained state of the athlete being a difficult one to maintain, owing to the precarious balance between the reproductive and destructive processes.

A more or less systematic plan of work was laid out last October to meet the altered conditions caused by the new compulsory gymnasium schedule. The previous year's work for the fourth class having proved somewhat unsatisfactory, attention was called to the Swedish System of Physical Training as used in the British Navy. These exercises were first tried out experimentally, and then beginning with the present fourth class last summer were gradually applied to the midshipmen.

The effect on the present fourth class, after a short period of work during the heat of summer, together with the result of the winter work, on all classes, as tabulated below, will no doubt be convincing.

TABLES OF COMPARISON RESULTS IN WEIGHT AND STRENGTH.

POSTURAL RESULTS, OCTOBER, 1911.

First class	41	% defective.
Second class	35	"
Third class	20.5	"
Fourth class	23	"

The results of the posture test showed the prevailing defects to be those of the student (head drooping, upper chest flat, and abdomen protruding (sway back)). Many presented a lowered right shoulder due to slouching or yielding in the spine under the weight of the rifle from too frequent carriage at "Shoulder-Arms." The effect of poor posture is to cramp the action of the heart and lungs, and as a result deficient oxidation takes place, this affecting metabolism within the body.

The April test disclosed that with one or two exceptions in each class all midshipmen could assume the position of correct carriage of the body, the effect (even in mature individuals) of the Swedish exercises being very pronounced in developing the chest, in loosening the joints, in stretching contracted muscles, and in

adjusting the spine. Correct posture is not yet a habit, however, and some method (now lacking) must be devised to counteract the constant assumption of poor position during the numerous study and recitation periods daily, which tend to overbalance the good effect coming from the limited military and gymnasium drills.

RESULT OF OCTOBER STRENGTH TEST ARRANGED IN PERCENTAGE ACCORDING TO NUMBER OF DEFECTS.

	Qualified.	1 1 to 5 defects.	2 6 to 10 defects.	3 11 to 20 defects.	4 Over 20 defects.
First class.....	27.5	39.6	8.7	13.8	10.4
Second class.....	31.2	48.9	6.1	9.6	4.2
Third class.....	34.7	47.0	1.1	9.2	8.0
Fourth class.....	31.5	32.7	10.9	10.1	14.8

FOURTH CLASS COMPARISON (SUMMER'S WORK).

		Qualified.	1	2	3	4
Allowance Standard	On entrance.	4.5	8.3	15.3	13.7	58.2
	October.....	31.5	32.7	10.9	10.1	14.8
First class Standard	On entrance.	1.6	2.0	4.1	9.9	82.4
	October.....	9.0	11.2	15.5	17.2	47.1

Remarks.—Midshipmen having 1 to 5 defects in strength were assigned one hour's extra gymnasium drill weekly until qualified. Those having more than 5 defects were assigned two hours' extra drill weekly. The classification is made on height with an allowance to lower classmen of one, two, and three inches, to permit of progressive development and allow for youth.

Of the 479 midshipmen who failed to qualify in strength last October but 30 remain (May) and these have minor deficiencies.

The following table shows the weight and strength results at the different tests for various classes:

Class	Average weight Oct. 1910.	Average strength Oct. 1910.	Average weight Oct. 1911.	Average strength Oct. 1911.	Average weight April 1912	Average strength April 1912	Pounds gain in weight 1911-1912.	Pounds gain in strength 1911-1912.
1912	145.0	4556	144.9	4641	149.3	5097	4.4	456
1913	142.7	4512	147.8	4684	150.1	5167	2.3	483
1914	135.8	3923	145.0	4612	149.5	5017	4.5	405
1915	[1]135.2	[1]3900	142.6	4390	[2]145.5	[2]4808	2.9	418

[1]On entrance 1911. [2]Represents about 10 months' development.

The following is to be noted in connection with the above results:

The ten classes 1900-1910 averaged in weight:

On entrance	132.6
As second classmen	146.5
As first classmen	145.4[1]

[1] A loss of 1.1 lbs. during first class year.

Comparison results in strength cannot be determined because of different systems in use, such results as could be determined showing an actual or relative decrease in strength during the senior years such as occurred in connection with the upper classes, 1912 and 1913 (see above). This decrease has been due undoubtedly to smoking and other privileges and to lack of sufficient physical drills.

The only drills hitherto affecting upper classmen in a physical way since the Spanish war, when the sailing cruises became more or less a thing of the past, are the disciplinary drills. All other drills have for these classes become mental in type rather than physical exercises. Weaker members of these classes for the past three years have been assigned about 16 hours gymnasium drill.

The question of arrival at mature development is often brought up as an excuse for the poor showing of the upper classmen. The result of the April strength test based on a minimum amount of gymnasium work the past winter has demonstrated a substantial average gain in weight and strength for these classes.

The present class of 1912, from October, 1910 to April, 1911, while second classmen, gained on the average 1.3 lbs. This gain disappeared before October, 1911, showing the characteristic tendency toward loss in weight of all previous first classmen. Under compulsory gymnasium drill this Academic year for the first time, this tendency toward loss has been nullified, and a gain of 4.4 lbs. recorded.

The average gain in weight and strength for the present third class from entrance in 1910 to October, 1911 (1 year and 4 months), was respectively 9.2 and 689 lbs.

The average gain in weight and strength for the present fourth class (10 months) has been respectively 10.3 and 908 lbs.

Those midshipmen who lost in weight and strength the past year can be placed under three classes: The largest number en-

gaging in strenuous athletics; a smaller number as members of the strong squad (few compulsory drills) apparently took no voluntary exercise, and so suffered from lack of work; and the fewest were those of frail physique, who are under weight for age and height.

The following shows the percentage results based on number of defects for comparison with the results of the October test (see above):

	Qualified.	1 to 5 defects.	6 to 10 defects.	11 to 20 defects.	Over 20 defects.
First class.....	85.5	11.2	1.9	0.7	0.7
Second class.....	90.3	6.9	2.1	0.7	0
Third class.....	95.1	4.9	0	0	0
Fourth class.....	93.5	5.5	1.	0	0
Fourth class compared with First class Standard.	33.8	42.3	14.4	8.5	1.

The following is arranged for general information in connection with the Swedish day's lessons and the description of the exercises which go with them. The exercises have been taken from the "Handbook of Physical Training" (British Admiralty) in use at the Naval Academy. A few additional exercises are described, requiring simple apparatus, and which can be substituted, if such apparatus is available or can be improvised, for the free standing "Span Bending" and "Heaving" exercises.

Each exercise has a title: "Standing: Heel Raising." The first part of the title denotes the starting position from which the exercise is done; the second part, the part of the body which is moved. The title is intended for the information of the instructor, but when the exercise is not well understood the second part may be announced as a preliminary *preparatory* command. Commands are of two kinds as indicated on page 357 of the "Landing-Force and Small-Arm Instructions, United States Navy, 1905."

Do not exercise just before a meal or within at least one hour after a meal (digestion will be interfered with otherwise).

The best time for exercise of any kind is between the hours 10 and 12 morning, and 4 and 6 afternoon. The Swedish exercises can be performed before breakfast, or even at bed time.

It is a mistake to eat a hearty meal before physical or mental work. The more food in the stomach the more mechanical inter-

ference in the neighborhood of the heart, and the less blood circulating in and purifying the organs affected by the exercise.

Exercise should preferably be done in the open air, and in the sun if not too warm. If indoors the room can go as low as 50° F. in temperature, and there should be free ventilation.

A loose light woolen garment should be worn to prevent too rapid radiation of heat. The clothing should be clean and should not be that used for daily wear.

The Swedish day's order is arranged to give the body a general warming up series of movements before the more strenuous effects, and at the end there is a tapering down series for a calming effect. In all exercise graduation should be practiced so as to accustom the parts and organs to the strain. In cold weather, especially, the muscle fibers can be torn easily if too much strain is applied before they have been warmed and loosened up.

In paired exercises begin with the left side, if right handed, or vice versa.

In the Swedish system there is little danger of producing fatigue (other than local), but it is best even here to cease exercising if fatigue is a prominent symptom. The fatigue meant is that due to exhaustion and not stiffness or soreness. Immature and older subjects should be careful not to exercise to excess.

Exercise should improve health, control, strength, proportion, and posture. If large muscles are sought the subject becomes less agile through limitation in response and range of motion. The large masses of tissue, furthermore, require abnormal nutrition and in the end tax the subject's vitality to a marked degree.

If breathlessness or heart palpitation appear cease exercising, and make slow leg movements, or lie on back with arms and legs stretched loosely apart and breathe deeply. Practice a breathing exercise. Any organic disease of course contra-indicates most forms of physical exercise.

Form is particularly necessary in carrying out any exercise, especially a Swedish exercise, departure from the designated method of performance in many instances nullifying the effect. It is better to do one movement in good form than several in bad form.

Make it a practice to relax the muscles not in use so as not to antagonize one muscle by its fellow of contrary action. Many men waste an enormous amount of energy in fighting their own

effort ("muscle bound"), thus making themselves slow, jerky, and clumsy, besides lessening their power of endurance by quickly forming within the blood an excess of waste combustive products.

Food replaces that which is lost within the body cells in the production of energy. Foods are of three kinds: (1) Proteid (white of egg, lean meat). (2) Carbohydrate (starch (potato, rice), sugar). (3) Fats (butter, olive oil). Briefly, the first forms flesh and the second and third are converted into heat, or stored up as fatty tissue.

As a rule the average man eats more than is needed and as the excess must be eliminated or stored up, the body cells are overworked to no good end and general vitality is by so much lowered.

No particular diet is necessary for even strenuous physical or mental labor provided moderation is practiced and ordinary precautions are taken in the selection of food, its proper preparation, the interval between meals, and avoidance of haste and deficient mastication in eating it. As mentioned before little or no food should be taken before work. It is the food of the day previous which furnishes fuel for the production of energy.

In warm weather less heat producing food is required.

Certain idiosyncrasies must be respected.

Persons with loose skins, the result of former excess of fatty tissue, are apt to vary greatly in weight (a loss of ten pounds from free perspiration after fairly violent exercise in warm weather being not uncommon).

During exercise water should not be taken as it has a mechanically bad effect on the heart. Rinse the mouth only. Await a sufficient interval after exercise before drinking freely.

Persons inclined to stoutness should exercise freely and diminish the fat producing foods. Restriction in the water supply is not a good plan as water is needed to carry away the ash formed from the combustion going on in the production of energy.

A certain amount of fat is needed as a reserve food supply, and when it is sufficiently removed so as not to mechanically interfere by its pressure or weight the subject should be satisfied.

Stimulants and tobacco do not go well with exercise.

Excessive mental work and excessive physical work do not go well together.

Sleep is necessary so that the overworked cells can have a chance to recuperate and replenish their fuel (food) supply.

A cold shower bath should follow exercise while the body is still warm and covered with perspiration. Hand friction should be applied to the skin at the same time. If the shock is too great start with a tepid shower and end with a cold one.

Warm baths should only be taken for cleansing purposes and at bed time (calming effect).

THE SWEDISH SYSTEM.

In general the object of any form of exercise is to create a condition of improved health, physique, muscle control (co-ordination), self reliance, courage (coming from the knowledge of ability that good muscular action brings), alertness of perception, quickness in response both mental and muscular, erectness of body, symmetry, endurance, etc.

The four distinguishing points of the Swedish system are:

1. The day's order.
2. Progression.
3. The use of the word of command for movements instead of imitation.
4. Insistence on form.

The day's order.—The exercises of the day's order are arranged so as to affect the body in a progressive way, the classes of movements following each other with but slight modification, always in the same way.

1. Introductory exercises are designed to give a light work-out for the entire body, to get the blood circulating and to loosen up the muscles and joints. They consist of movements for formation of the class, dressings, facings, openings, etc., exercises to correct posture, and easy exercises already well known.

2. Leg exercises are designed to stimulate the circulation of the lower extremities and prepare the body for the stronger Span Bend and Heaving movements. After exertion slow leg movements by bringing blood to these parts exert a calming effect on the respiratory and heart action.

3. Span bending exercises develop the upper dorsal (back) muscles and stretch the anterior chest muscles. The stretching effect counteracts the cramping and fixation effect on the chest of the anterior muscles, brought about by excess of work on ordinary gymnasium apparatus, certain forms of manual labor, and bad posture (school children, students). The separation of the

ribs which takes place keeps the chest supple and mobile and thus favors lung expansion.

4. Heaving exercises are designed to aid in the production of a good carriage, proper form as to the carriage of the chest and head being of more importance than the number of times one can pull up.

5. Balance exercises are designed to affect the nervous system and its relation to co-ordination. Attention is required at first until the antagonistic muscles are trained to work together, after which the process becomes an automatic one and the subject acquires the habit of moving with an easy carriage and perfect control, using the minimum amount of energy, with consequent less fatigue.

6. Dorsal exercises are designed to affect all the muscles of the spine, thus aiding in extension of the body and consequent erectness.

7. Abdominal exercises by strengthening and improving the tone of the abdominal muscles prevent a tilting forward of the lumbar spine (hollow back), a prevalent condition. They benefit the digestive organs.

8. Lateral exercises affect both sides, contracting one and stretching the other. The ribs are separated and the chest made more supple and resilient. The abdominal organs are benefited. The spine is made more flexible and any tendency to spinal curvature obviated. They give suppleness to the carriage of the body.

9. Jumping and vaulting exercises require control and develop judgment, presence of mind, quickness of movement, resource, courage, and the ability to turn a quickly formed idea into action. They accustom the person to using just sufficient muscular action and no more, and exhilarate the nervous system. Good form is of more importance than length or height overcome. Free movement and lightness in "Taking off" and "Landing" is necessary.

10. Breathing exercises are intended to exercise the muscles of respiration and mobility of the chest. They should be used only after the breathing is somewhat under control (light leg exercises being used first). Three times at one time is sufficient; and they may be employed at any time when the breathing has been disturbed.

11. Marching and running exercises aim to educate the body to a free and easy movement of the hips, lifting and placing of the

feet, and to improve the carriage. The progression in running should be very gradual, the duration of a run never to exceed 5 minutes. This will gradually cause the heart and lungs to adjust themselves ("wind") so as to work together economically. The pace in running should be no more than a dog trot at first and even at the end.

12. Finishing exercises are light exercises already known with a preponderance of slow leg movements, and breathing exercises, with the object of calming down the nervous and circulatory excitement following the more violent movements. They tend also to act as correctors of posture.

Progression.—No exercise should be performed as a rule more than four times, and the most violent only once. A change from an easier to a harder exercise should not be made until the easiest is done in good form.

Word of command.—Use of fixes attention, and sets up nervous impulses to the muscles concerned which are a direct response to an effort of the will and not reflex or automatic in character.

As an example of the effect of mental concentration on a muscular movement it is to be noted that the muscle group directly concerned in throwing the leg forward in walking or running is the only group in the strength test applied to midshipmen which proves to be stronger on the average on the left side than its fellow of the right side. This excess of strength is brought out undoubtedly by the necessity of stepping forward with the left foot first in all military formations.

Form.—General faults in form consist in holding the breath during the performance of an exercise; contracting the chest by a bad carriage of the head, neck, and shoulders; or performing the exercise unevenly or incorrectly. Other faults are described in the description of each exercise. The performance of an exercise in good form influences to a marked degree the effect. An apparent easy exercise in bad form becomes a difficult one when done in good form.

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SIMPLIFIED METHODS OF COMPASS CORRECTION.

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The method, which is here to be described, has worked successfully for two years with the compasses of the *Castine* and all the submarine flotilla. The German and Greek letters, ordinarily used, are here done away with, and thus the biggest bugbear of compass work is eliminated, the constant *A* being the only coefficient given real consideration in this method.

We consider that any compass is properly corrected when a distant object can be made to have the same compass bearings for all headings of the ship.

To Compensate the Compass.

Note the change of bearing of the sun for every twenty minutes, using the azimuth tables, the approximate local apparent time, the latitude (correct to a degree), and the date of the month as arguments. A curve of the sun's change of bearing is then plotted on cross-section paper. A reference to the azimuth tables shows that an error of a few minutes in time, of a degree in latitude, or even of a day or so in date, make practically no change in the rate of change of bearing of the sun; though, of course, with such erroneous data there is a decided error in the actual bearing of the sun, but with the actual bearing we are not now concerned.

Problem.—Correct all compasses of a vessel, and swing for residuals in latitude 40° 20′ N., λ 70° W., about 3.00 p. m. on October 30.

Procedure.—1. Set watch to local apparent time approximately. For example, if watch had been keeping 75th meridian mean time, as would be probable, set it ahead twenty minutes, thus making it 70th meridian mean time, and then apply the equation of time.

2. Pick out from the azimuth tables, using 40° as latitude, and the column nearest the day of month—October 31—bearings of the sun at 20-minute intervals, viz:

Time.	Bearing of sun.	Change of bearing per 20 minutes.
3.20	106° 10′	.....
3.40	102° 14′	3° 56′
4.00	98° 34′	3° 40′
4.20	95° 05′	3° 29′

Using cross-section paper, taking ordinates as times, and abscissæ as degrees—unnumbered as yet—now draw in the curve *ABC* (see Fig. A).

3. Now head the ship north. Using the azimuth circle take a very accurate bearing of sun; in this case it equals 246° 30′ at 3.22. Put the helm over and swing to south. Plot point *X*, with this data, on Fig. A, close to the change of bearing curve, now marking the degree line at *A* as 246°, and also giving values to the abscissæ.

4. Steady on south. Bearing of the sun is found to be 245° 30′ at 3.29. Plot this as point *Y*. Draw *XX′* parallel to *ABC*. *X′*, therefore, represents the sun's bearing if headed on north at 3.29. Now draw a curve parallel to *ABC* and through the point *Z*, which is half way between *Y* and *X′*.

5. Now, using watch and curve, raise or lower the athwartship magnets until sun bears as it should. Then there will be no deviation, and south by compass will be correct south. All the other compasses are then made to read south in the usual manner.

6. Correct on east, and then on northeast in the same manner.

7. Head the ship north. If there is a difference in bearing from curve, one-half of this is deviation. Plot point, and, swinging on every fourth point, plot differences and draw curve through the mean of points. Those points to the left then are westerly deviation, those to the right being easterly.

If, however, there is a real constant magnetic error, it is not known by the above method, it is not and should not be taken out on one heading, as the error due to it would then be doubled on the opposite heading. The navigator's error is quite frequently the constant which makes the work check.

Now, to find the constant error, compute an actual bearing of sun and compare. For example, if the compass error at 7 a. m., and again at 10.30 a. m., on the same heading, is exactly the same,

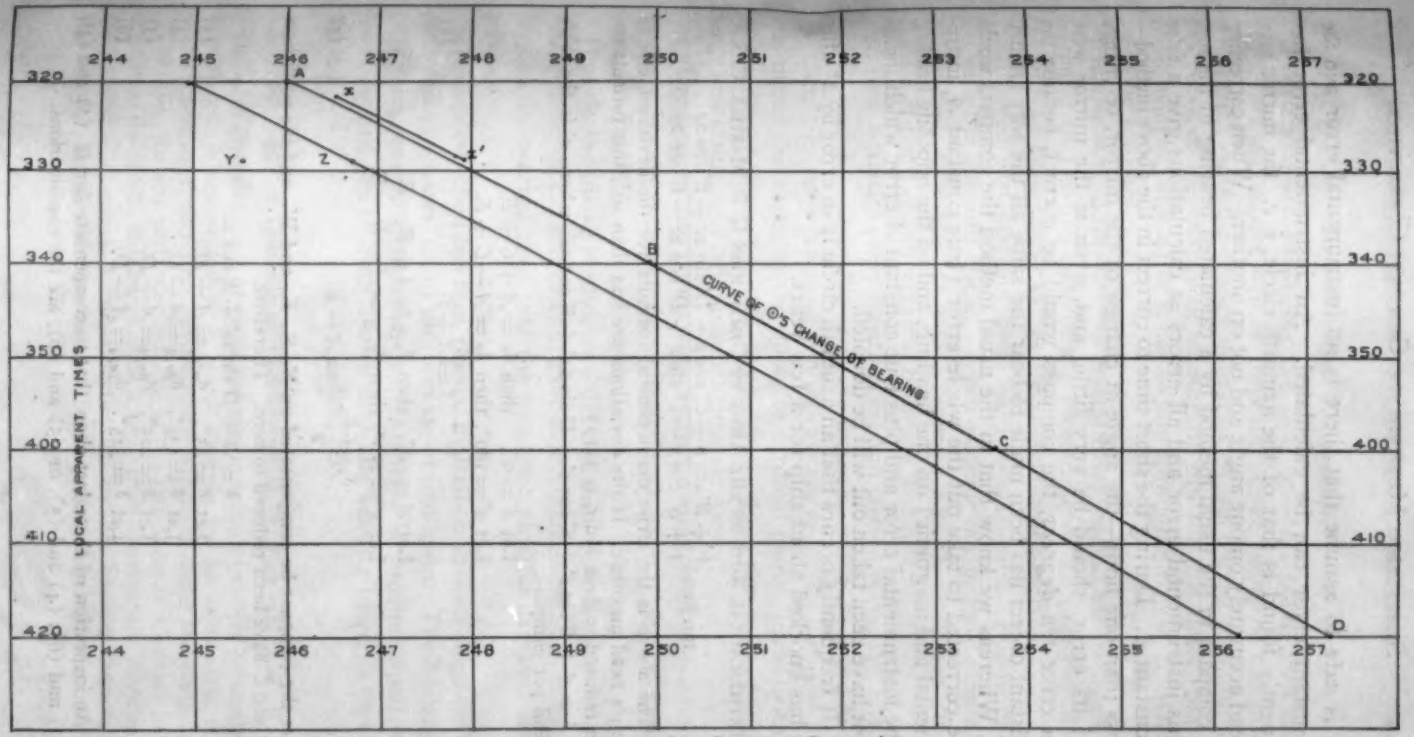


FIG. A.—Curve for Compass Correction.

Ordinates, Approximate Local Apparent Times. Abscissæ, Azimuths in Degrees.

it is safe to assume that there is no instrumental error and the constant error can be calculated. An instrumental error frequently found is that of the azimuth circle, *i. e.*, the mirror may read accurately on one angle and not on another. When correcting a compass in the usual method by a calculated bearing of the sun, this instrumental error and all errors in calculations give a false constant A. During the short time to correct in the above method—less than one hour—the angle of change of the mirror, or change of its error, should be very little, and, even if the mirror were in error *ten degrees,* the compass would be correct, because the distant object has been made to bear the same all the way around.

Whereas we know that in the usual method the compass would be corrected to take out the whole error (true constant A, instrumental and magnetic) on one heading, and on the opposite heading the instrumental error and plus true constant A error which should not have been taken out will be doubled.

It frequently occurs that an azimuth circle is in error by 2° after it has knocked about ship for a few years.

MATHEMATICAL NOTE ON THE ABOVE BY COMMANDER G. R. MARVELL, U. S. N.

$$\tan \delta = \frac{A' + B' \sin z + C' \cos z + D' \sin 2z + E' \cos 2z}{1 + B' \cos z - C' \sin z + D' \cos 2z - E' \sin 2z}.$$

The above is the strict mathematical formula for the deviation, z being ship's head magnetic. If the deviations are less than 20°, this formula can be reduced to (see Muir, p. 121):

$\delta = A + B \sin z' + C \cos z' + D \sin 2z' + E \cos 2z'$, where z' is the ship's head per compass.

Let $z' = 0°$, then $\delta_0 = A + C + E$.
Let $z' = 180°$, then $\delta_\pi = A - C + E$.

$$\frac{\delta_0 + \delta_\pi}{2} = A + E. \tag{1}$$

Let $z' = 90°$, then $\delta_{\pi/2} = A + B - E$.
Let $z' = 270°$, then $\delta_{3\pi/2} = A - B - E$.

$$\frac{\delta_{\pi/2} + \delta_{3\pi/2}}{2} = A - E. \tag{2}$$

Let the compass be compensated on N., S., E., and W., and the coefficients B and C have been reduced to zero. Therefore,

$$\delta = A + D \sin 2z' + E \cos 2z'.$$

Let $\delta = 45°$. $\delta_{\pi/4} = A + D$. (3)
Let $\delta = 135°$. $\delta_{3\pi/4} = A - D$. (4)
Let $\delta = 225°$. $\delta_{5\pi/4} = A + D$. (5)
Let $\delta = 315°$. $\delta_{7\pi/4} = A - D$. (6)

An inspection of these last show that to compensate for D, (3) and (4), (3) and (6), (4) and (5), or (5) and (6), are the combinations.

TO SWING FOR RESIDUALS.

If deviations are small, say not over one-half point, then the "lag" of the compass will be constant, if the swing of the ship is constant. Note the change in bearing of sun during 10 minutes. Plot curve of the change of bearing of sun for this time. Start vessel swinging and, after it has swung through 8 points, consider the swing constant.

Example.—1. With data, as in first case, we find the change of bearing from 3.50 to 4.00 to be 2°. Plotted curve *AB* (see Fig. B), and without designating values for ordinates or abscissæ.

2. Headed east and put helm hard to starboard. Follow the sun with the azimuth circle. When passing north, took azimuth and time—*i. e.*, 268½° at 3:51. Now, in Fig. B, mark 268° for abscissa at point *A* and 3:51 for ordinate, and plot N.

3. Took bearings every fourth point and plotted NW., W., SW., S., SE., and E. From the mean between N. and S., E. and W., NW. and SE., and NE. and SW., draw curve *XY*. By mean is here meant the mean of the opposite cardinal points, or adjacent intercardinal points. Or, this may be drawn from the mean of only north and south, and still be approximately correct.

4. The amount the points vary from this line is the deviation, plus any known constant the compass may have. The result is shown in Fig. B.

Thus, in the above method, we did not need to know the magnetic bearing of the sun (any distant object could have been used), because the bearing used was the magnetic plus the lag plus the constant.

The above method has been proved by trial on various ships with corrected compasses, using uniform speed and helm. The bearing of the sun remained constant, or only varied an amount equal to the change of sun bearing due to time, the bearing being in error the lag.

NOTE ON "LAG" OF COMPASS BY COMMANDER G. R. MARVELL, U. S. N.

The mean directive force of earth and ship in terms of earth's horizontal force as unit is represented by λ, which depends for its value upon the effect of horizontal soft iron, symmetrically arranged about the compass. Therefore, for any particular heading of the ship there is a certain pull or force on the needle, tending to draw it away from the magnetic meridian, and to bring it to rest at compass north. On another heading there is a similar force, but of different value. If a ship is swung with a constant

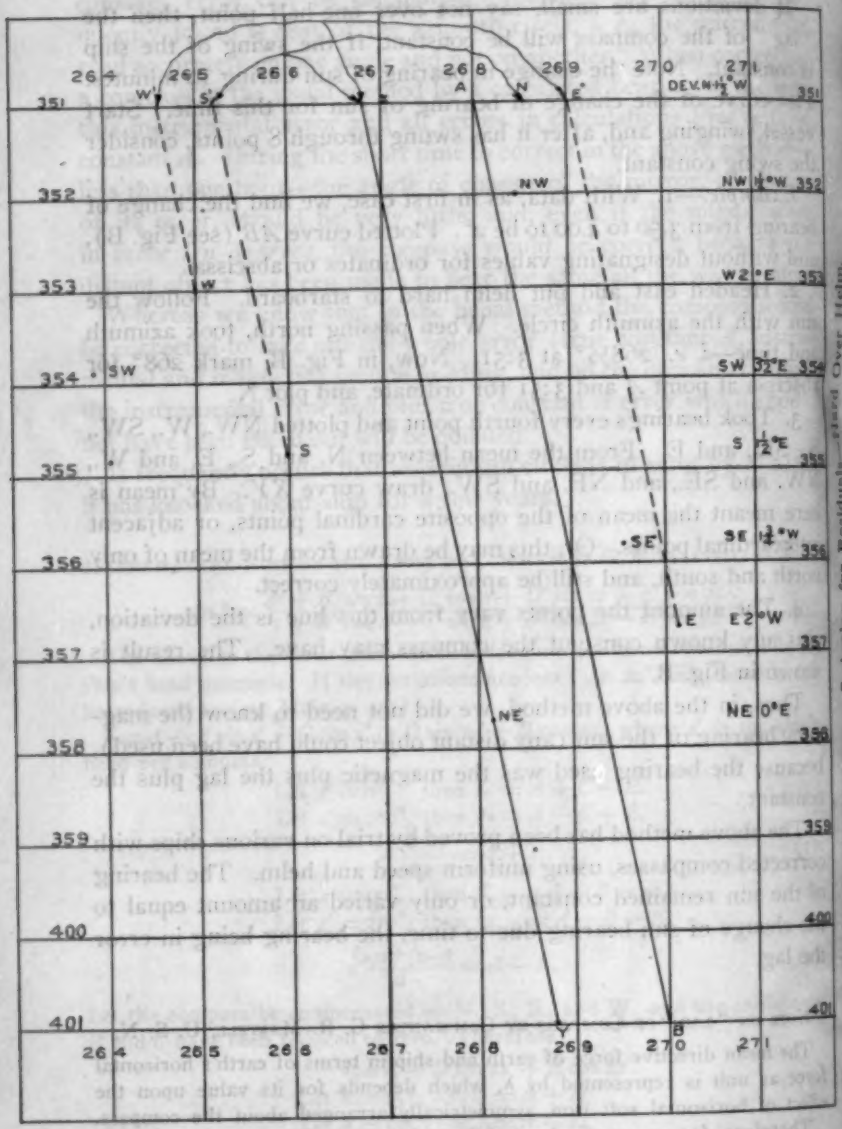


FIG. 2.—Curve Sighting for Residuals—Yard Over Helm. Amplitude, Azimuths or Bearings, Coefficients, Approximate Times.

change of magnetic azimuth, the compass needle will be acted upon by a varying force, so that at any particular magnetic head the deviation will be different from what it would have been if the ship had been steadied on that magnetic head. This difference in deviation may be called "lag." If the force acting on the compass needle was constant, and the angular velocity of the swing was constant, then the lag would be constant. But in an uncompensated compass the force is variable, therefore the lag is variable.

By the method of compensating described above, the compensation on N. and S. gets rid of C, but leaves A and E; the compensation on E. and W. gets rid of B, but leaves A and E; that on NE. and SE. gets rid of D, but leaves A. The value of the force of earth and ship to magnetic north is given by the formula

$$F = \lambda(1 + B' \cos z - C' \sin z + D' \cos 2z - E' \sin 2z).$$

This in terms of earth's horizontal force as unit.

Assume that B', C' and D' have been eliminated by compensation, and the value of $\lambda + E'$ with correctors in place has been found, then the formula reduces to

$$F = \lambda(1 - E' \sin 2z).$$

If E' is very small, as it is in all centrally located compasses, then the value of F practically remains constant, and therefore the lag is constant.

If the compass is out of the midship's line, and the rods d and b have effect, then the method of compensation, and of finding residual deviations given above is faulty and should not be depended upon.

However, if the deviation has not been entirely removed, the lag will not be constant, for there will remain values for B', C', D' and E', which, when substituted in the formula for force, will give varying values of that force.

The amount of difference in the lag cannot be stated; it may, or it may not, affect the finding of the correct deviation.

TO CORRECT COMPASSES—NO INSTRUMENTS EXCEPT AZIMUTH CIRCLE. NO TABLES OF INFORMATION OF ANY KIND.

1. Steady ship on one course; note bearing of sun and, again, about 10 minutes later; from these two bearings one can tell whether the bearing is increasing or decreasing, and approximate rate. In this case it is noted that the bearing is increasing between 1° and 2° every 10 minutes. Call it about 10° for every 7 minutes. If no watch is available, note approximately the number of revolutions for 1° change in bearing. All that is necessary is some very rough method of measuring time, and even this is hardly necessary for accurate work.

2. Procedure: Head north; sun bears 270°; head south, steady about 2 or 3 minutes; sun bears 276°; time interval about 6 minutes. Six minutes sooner the bearing would have been 275°—

the average is 272½°—in 6 minutes, therefore, the bearing would increase 1° and the sun should bear 273½°; so raise or lower magnets and, as a little time will be consumed in this operation, make sun bear between 273½° and 274°. Head east and west, same procedure. Head northwest, then southwest, and follow the same procedure.

On southwest or northeast the natural deviation is east; if it is found to be west the compass is overcorrected and it is necessary to move balls out. On northwest or southeast natural deviation is west; if found to be east, then compass is overcorrected and we must move the balls out. If the above cannot be remembered, simply move the balls and find out what happens.

Now put the helm hard over and, after swinging through eight points, take bearings every fourth point, and proceed as in the method of swinging for residuals, with hard over helm. If the work was accurately performed, it will be found that the bearing all around will be the same, or about ½° more by the end of the swing, due to change of bearing of sun in the time interval.

FLINDERS BAR CORRECTION.

1. Being on the magnetic equator correct compasses, after going north, a deviation is observed. Using rectangular method of Flinders bar, take out this deviation. (In general, it will be found that either a very weak or no Flinders correction is required on the side of the compass.)

2. The vertical magnetic force varies as the sine of the magnetic latitude, or, to express it differently, the vertical magnetic force varies as the sine of the dip. In latitude 14° 31′ north, corrected compass, sine of 14° 31′ equals ¼ (no Flinders bar in). In latitude 30°, noted deviation on east course equal 2° W. Sine 30° equals ½. Place Flinders bar ahead of compass, add rods until deviation is 2° E. Similar procedure on north heading.

3. The pull causing the deviation in latitude 30°, sine ½ is twice as much as the pull in latitude 14° 31, sine ¼; so the deviation caused by vertical force, or caused by the magnetism in vertical soft iron, is twice as much in latitude 30° as in latitude 14° 31′. The actual deviation caused by vertical soft iron in latitude 14° 31′ is thus 2° and in latitude 30° is 4°. The compass must then be changed 4° by Flinders bar, but, having been corrected with magnets in latitude 14° 31′, there is now a deviation of 2°; this is to be taken out by correcting with magnets in the usual way.

While this method of Flinders bar correction has not been proved by actual trial, it is believed to be correct.

NOTES.

When first beginning compass work the author started with a carefully worked out magnetic curve, but nearly always found that, after compensating on north, the sun's bearing on south was not according to the curve. So, judging this due to mathematical, instrumental variation, or a constant magnetic error, a curve was drawn half way between the worked out curve and the south compass bearing, and it was found that this curve could be followed all the way around. Then a curve of proper shape only was found to be all sufficient.

If the compass tray is immovable, wires can be added, but do not do so by the bundle; magnets can even be nailed to the deck. It has been found beneficial to have the compass balls annealed by heating to a dull red and cooling slowly over night, about every six months, as they collect a little permanent magnetism.

The above methods are certainly simple, easily taught, form a practical method of compass correction, and eliminate the difficulties ordinarily met with in this work.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

AVIATION IN THE NAVY.*

By LIEUTENANT E. LAPOINTE, French Navy.

Translated by ASST. NAVAL CONSTRUCTOR JEROME C. HUNSAKER, U. S. Navy.

PREFACE.

In spite of the daily feats of the aviators, there are still a great many men who will not admit that aviation can ever have a practical application, and I have often seen all argument in favor of flying machines meet with hostile incredulity or absolute denial.

But this is not surprising when we consider such predictions as these:

> "A steamer will never cross the Atlantic;
> The bicycle can serve only rare acrobats;
> Horseless carriages will never be practical."

How few years it is since results have given the lie to such pessimistic prophesies! Such manifestations of the law of inertia retard progress and can become prejudicial and even dangerous. This paper is an attempt to combat this tendency and to create in the navy that favorable atmosphere, without which a new invention makes slow progress.

The advantages that the navy may expect from aviation are great indeed, but before discussing them, I wish first to establish the possibilities of flying machines of the present day and the very near future. The latter could be easily defined if we could calculate the reactions upon oblique plane or curved surfaces, moving through air. Or again, if there existed some formula by which we could describe with numerical quantities a flying machine to fulfill given conditions. But the problem is analogous to the design of a war ship, and does not admit of a direct or "a priori" solution. Nevertheless, our designers succeed in building excellent ships; and there are already successful flying machines, and better ones still will be developed by attention to the following principles: Careful study

* Librairie Militaire R. Chapelot & Cie., 30 Rue et Passage Dauphine, Paris, 1910.

of experiments already made, precise observation of the flight of birds (which give us perfect experimental models), application of the principles of naval architecture to aeronautics, and the pursuance of methodical tests suggested by theories, which, even if tentative, will be successively more fruitful and nearer truth.

The scope of this paper does not include a history, however brief, of the experiments in aviation up to the present day, nor a treatise on aviation. But to facilitate a critical and comparative study of flying machines of different types, I will give a discussion of the governing principles.

ACTION OF AIR ON SURFACES.

Coefficient k—Center of pressure—Equilibrium and stability of aeroplanes.

If a thin plane move uniformly through a fluid at rest, or if this plane be held stationary in a uniform current in which each particle moves in a parallel path in the same direction, and if we assume the plane and the fluid to be perfectly elastic, and finally if we assume that each particle of fluid disappears after having exerted its action on the plane—then with these assumptions we may write (after Newton):

$$P = kSV^2,$$

"P" being pressure in the direction of the current; "S" the section of the column of fluid intercepted by the plane, or the projection of this plane on a plane normal to the direction of the current; "V" the uniform velocity of plane or fluid; and "k" a coefficient given by

$$k = \frac{d}{2g}$$

when "d"=density of fluid, and "g"=acceleration of gravity.

For air of density 1293; k=.065, and expressing velocity in meters per second, and surface in square meters, the pressure will be in kilograms.

The theoretical formula is true, not only for a thin plane, but for any surface—normal, oblique, plane, convex, concave, large or small, circular, square, rectangular, rough or smooth—under the expressed condition that the above assumptions are made. It is precisely because these assumptions are neglected that we have interminable and futile discussions of the coefficient k. Air is not perfectly elastic, and besides being viscous, does not disappear after

having impinged upon a point of a surface, but reacts upon the neighboring air particles. In practice, the formula $P=kSV^2$, on which is based all the theory of aviation, has little value, and can be used only with caution. Confidence in this formula has caused many an aviator to lose his time and money, and sometimes his reason.

Numberless experiments have been made to determine a "practical coefficient k," but without success except in the most simple cases. Certain writers have attempted to introduce a new coefficient; others have proposed fractional exponents not well defined, and still others have added corrective terms of more or less complexity.

We have the following:

$$P=k\lambda SV^2$$
$$P=k\lambda S^{\alpha}V^{\beta}$$
$$P=A+BV^{\alpha}+CV^{\beta}+\ldots.$$

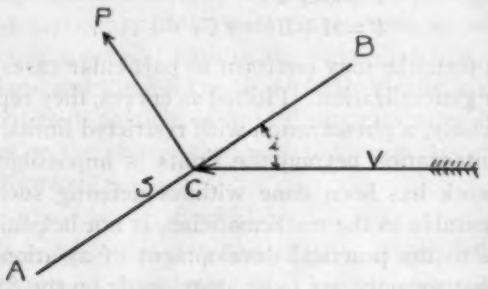
All such formulæ may conform to particular cases, but are not suitable for generalization. Plotted as curves, they represent, more or less precisely, a phenomenon with restricted limits, but exterpolation or integration beyond the limits is impossible. Much interesting work has been done without defining such limits, and though admirable to the mathematician, is not helpful and is often an obstacle to the practical development of aviation. This does not mean that formulæ are to be abandoned; on the contrary, more calculation must be brought into the design of flying machines. For this we require careful analysis of complex phenomena, and the determination of coefficients with precision, for practical formulæ. Such work can only result from methodical experiments in testing laboratories specially equipped, such as the several aerodynamic institutes founded already in France and abroad, from which much is expected. Even though aviators, disregarding for cause the unsatisfactory coefficient k, have constructed machines that fly well, they still wait for important improvements. Such improvements can only become possible through the work of the theorists, just as the first aeroplane was the result of the theoretical research of many men.

The following method is generally used in the study of the reactions on an aeroplane. Of all mechanical forces, inertia is most often neglected. Inertia introduces a resultant force and a couple, nearly always disregarded. The resultant force can be resolved

into two principal components, one vertical or sustaining, opposed to gravity, and one horizontal, nearly opposed to the movement of the machine. It has been attempted to determine the relation between these components and the resultant, and being variables, they have been expressed in curves the parameters of which are arbitrarily assigned. But since these parameters cannot easily be determined experimentally, there has been a natural tendency to neglect one or more, with the result that generalizations so made have been found disappointing.

An example may show this better, and we choose that one which forms the basis for all study of the aeroplane.

Given a thin rectangular plane "*AB*" inclined in a current of air of uniform velocity *V*, we will show how our problem is less simple than it appears.



If the theoretical conditions given above for the coefficient *k* were to hold, the reaction of the air on the plane would be of a magnitude determined by a function of *S*, *V* and *i*, in a direction normal to the surface, and applied at the center of figure. But in practice, particles of air striking the plane do not disappear, but react upon their neighbors. The stream lines of air are deviated at the forward and after edges as well as at the sides. An eddy is made on the forward face with an increase of pressure, and an eddy on the back with a decrease of pressure. The difference of pressure on the two faces leads some aviators to say that the back of the plane is more effective than the face exposed to the wind; but when we consider a wing of material thickness, it is obviously necessary to consider the profile of each side. The wake left in the rear has a different section from the projection of the surface upon a plane normal to the direction of movement, and eddies exist along the edges of the wake.

Theorems of momentum and moment of momentum can be applied to aeroplanes and aeroplane propellers only with reservations which cannot be neglected, as is permissible for oblique surfaces moving through water.

Finally, it follows that the reaction upon the plane is not normal, but generally inclined forward, for small angles of incidence. The point of application, or center of pressure, is nearer the leading edge than the following edge, a most important consideration for equilibrium. The magnitude of the reaction is also very different from that indicated by calculation, but the true reaction, fortunately, is the greater, often by a considerable amount.

Even this incomplete analysis shows why study of the coefficient k is so deceptive. The direction of the stream lines is affected by the inclination at the leading edge; by the different inclination at the following edge; by the curve given to a surface; by the thickness applied to the back of such surface; by the dimensions of the surface; and by the relative force and direction of the wind. One can understand how it will require a long and varied series of experiments to establish a formula to give the magnitude and direction of the force of the air upon a surface in motion, and to determine the best profile for an aeroplane wing.

But it is not necessary at once to attack the entire problem. It will be expedient first to determine the best profile, basing the work on those characteristics which experience has shown to be of value. Surprising as it may appear, almost nothing of this kind has yet been accomplished. It is thought, for reasons more or less vague and often false, that a curved surface is better than a plane, and experiments have shown for the curved surface a greater sustaining power for less resistance. At ordinary angles of incidence, the center of pressure remains more nearly fixed in the vicinity of the center of figure for curved surfaces. But for very small angles of incidence, the center of pressure for a curved surface may suddenly shift toward the leading edge, endangering the equilibrium of the aeroplane.

Profiles following the arc of a circle have been very generally used, with a height of arc from 1/15 to 1/20 of the chord. Some constructors have given such thickness to the wings that the profile of the back and face are not the same.

The above analysis shows the great importance of the leading and following edges of the plane, and the conclusion is that in

choosing a profile for a wing of an aeroplane, careful study must be made of the influence of these edges with a view to regulating the cutting of air by the leading edge and the flow of air past the following edge. The stream lines must be made as easy and uniform as possible, and eddies or whirls must be eliminated or at least kept to a minimum.

Conclusions from observation of the flight of birds, from several significant experiments, and the comparison of certain forms for hulls of ships, permit us to suggest modifications to apply to the concave profile actually in use. There will certainly be a profile similar to Fig, 1 for the lower face; a concave part *BC*, following a curve which will not always be an arc of a circle; a convex part *CD*, raised forward in a manner to insure pressure always on the lower side and so avoid being taken aback; and a rear part *AB*

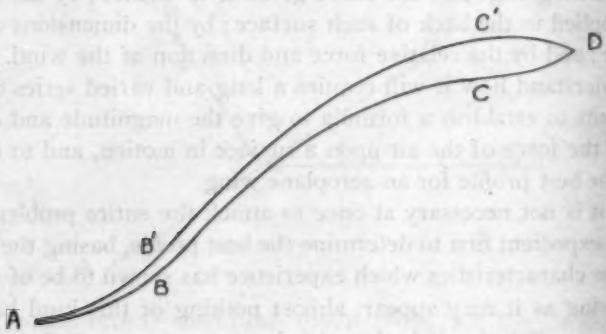


Fig. 1.

probably slightly convex. The relative importance of the sections *AB* and *CD* with respect to *BC* should vary greatly with the speed and with the size of the wing. And there will not be similitude between wings of only slightly different dimensions. The profile of the back *AB'C'D* must be studied experimentally with the face *ABCD*.

To avoid errors of exterpolation, the experiments should not be made on small models, and this restriction should affect the organization of aerodynamic laboratories. The method of testing in open or closed tunnel, however advantageous, becomes on this account impracticable, and we must resort to traction in still air with its obvious difficulties. The degree of precision obtainable in towing a full-sized surface at 30 or 40 meters per second even with a breeze of 3 or 4 meters per second, will be at least as great as one could claim for a tunnel experiment, where a reduced model is held

stationary in a current of air. Therefore, in the open air, without an immense hangar, we often can have a wind of less than 3 or 4 meters and can conduct very satisfactory experiments. Thirty meters per second may seem at first excessive, but already aeroplanes have made 17, 20 and even 25 meters per second, and with better profiles we may expect 30 meters velocity and over.

One of the first tests should be to tow in air, at a speed of 40 meters per second, elements of aeroplane wings, having various profiles, with full-sized width between entering and leaving edges, and of sufficient length to reduce the effect of air escaping from the sides. By measuring for each element tested, the resistance, lifting power, and pressure at various points on the back and face, we could shortly arrive at the best profile for any given speed and size.

So far, I have only discussed the efficiency of the lifting surface of the aeroplane—the greatest lifting power for the least resistance to propulsion. But if our aeroplanes of to-day need improvement in this respect, how much more is improvement required from a consideration of stability and equilibrium.

EQUILIBRIUM AND STABILITY.

Most writers, theorists as well as constructors, assume that an aeroplane is in equilibrium when the resultant of the weight and the thrust of the propeller is equal and opposite to the reaction of the air on the sustaining surfaces. However, this definition is obviously inexact because no account is taken of the forces of inertia, often most important. In fact, a static equilibrium is assumed, in place of an actual dynamic equilibrium. This error has retarded the solution of the problem of flight, and still hinders progress. Equilibrium, according to this theory, is to be secured by lowering the center of gravity. Practical operation of aeroplanes has shown that the system rocks about successive centers of pressure, as if according to a sort of metacentric curve. Such oscillations reduce the lifting power with reference to the thrust of the propeller, augment the resistance to propulsion, and may finally render flight impossible. There is danger in bringing the center of gravity too near the sustaining plane, because the slightest variation in the force or direction of the wind may produce a sudden change in the position of the center of pressure, and the machine will dive, or tilt up vertically—a no less dangerous performance. However, such oscillations of the machine can be much reduced by making the center of pressure more nearly fixed in position.

Avanzini's formula and similar ones are no more exact than those which pretend to define the coefficient k, but it is known that the center of pressure moves along the middle line of a surface, from the mid point an indeterminate distance toward the leading edge. In any case, this displacement of the center of pressure is proportional to the width of the surface in the direction of flight.

It follows, that for a rectangular surface, this displacement is least when the surface moves in a direction normal to the longer side. It is in such a manner that birds and our successful aeroplanes utilize their sail area.

There are a few who still defend the wing with the long side in the direction of flight, but the advantages of such a rig are purely theoretical or limited to particular cases.

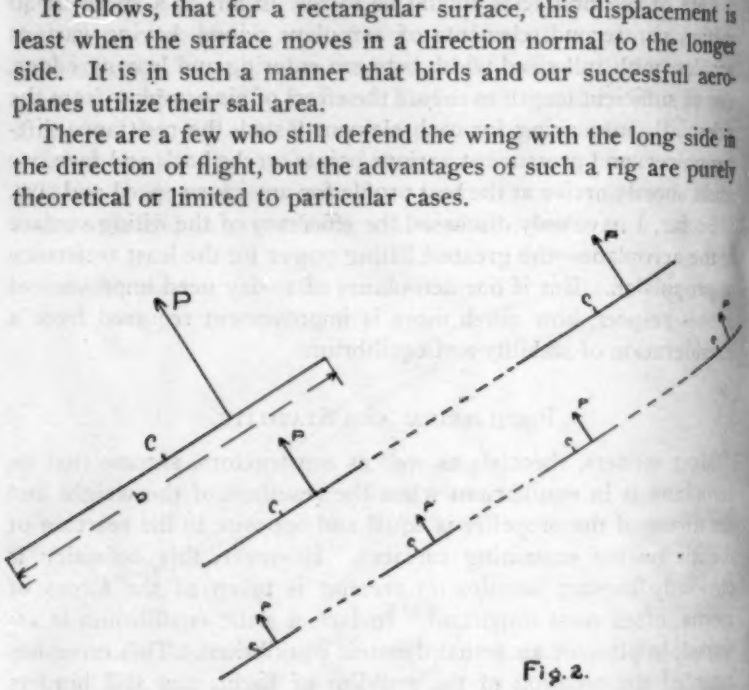


Fig. 2.

If we divide the surface into two parts placed one before the other, as in Fig. 2, the displacement of the center of pressure of each part (and hence of the resultant center of pressure of the whole wing) will be reduced by one half. And if we divide into N parts, the movement of the center of pressure is reduced to $\frac{1}{N}$ th of its former value. If, in addition, the surface of two sections have a wide gap between sections, the moment of inertia about a transverse axis is increased and the effect of the movement of the center of pressure reduced.

These considerations have suggested multiplanes. Good results may be expected from two pairs of wings, but further multiplication of surfaces has disadvantages which will appear later.

If, however, we attempt to fly models, made with two equal planes in tandem or with two biplanes of equal size, we will need to cut down the rear planes to a small fraction of the size of the forward plane. With such a tail remaining, we will have sufficiently reduced the oscillation of the center of pressure and its effect on longitudinal equilibrium. Some inventors have made this tail movable, to use as a horizontal rudder or depth governor. This is evidently a mistake, for we cannot expect such a rudder to act also as a sustaining plane. The tail should be stationary, although it may be of advantage to change its position to adapt the aeroplane for soaring without power " vol plané," or to carry very different loads. This, however, is a refinement not important at the present stage of development. Whether the tail shall be in the prolongation of the forward surface, or given the same inclination, are questions to be studied. There would seem to be an advantage, if the tail contributes to sustaining the weight, but some otherwise excellent designs have abandoned this claim in order to provide a necessary security against capsizing. This could be better accomplished in other ways, especially by raising the rear edge of the wings.

The tail or appendage has certain disadvantages. It adds to the complication of the machine, and is liable to be damaged in rising or landing; which operations it renders more difficult. In addition, the tail, with the necessary structure to connect with the principal surface, adds considerably to the weight and to the resistance to propulsion. Several well-known machines have almost no appendage, for their designers have provided a tail plane, smaller in area and much nearer the central structure than is customary in French practice. The result is an apparent simplification and handiness, but flight becomes more difficult and fatiguing.

The importance of the appendage varies inversely with the moment of inertia of the machine about a transverse axis. In the first aeroplanes and dirigibles, the value of the moment of inertia was too low, but that is not reason for us to exaggerate it. For, if a large moment of inertia diminishes oscillations, on the other hand, it becomes more difficult to check swinging started by any accidental cause. For example, the behavior of submarines has been improved by weighting the ends, while such a system of loading makes a ship pitch badly at sea.

A fixed tail should dampen accidental oscillations in the longitudinal plane, and a horizontal depth rudder cause the aeroplane to rise or descend. This rudder is nearly always placed in front, and

in such a position, contributes to sustentation. However, when the horizontal rudder is placed in rear, as in a few machines, there seems to be no loss in maneuvering power. This rudder is an important accessory and will undoubtedly be modified when we have determined upon the best wing profile. Its action should be partially supplemented by wings movable about a horizontal axis, by the simultaneous movement of ailerons, or by warping the wings. These three solutions are more or less completely in use at the present day, and when considered in connection with the vertical rudder, have an important effect upon lateral equilibrium; *e. g.*, with respect to a vertical axis.

This lateral equilibrium has small effect on a straight course, because of symmetry about a vertical longitudinal plane through the center of gravity. But in turning its study becomes most important.

A vertical rudder would seem to be the most logical means of steering, but the action of such a rudder, placed in rear, will disturb transverse equilibrium. The force of inertia enters here and must be considered. With the rudder inclined there will be a capsizing moment and a turning moment, which will not necessarily be the same as for a ship; for an aeroplane differs essentially from a ship in that the former is submerged in the element that bears it, the distribution of weight with respect to the different centers of pressure is entirely different and the vertical surfaces, which give stability of steering, are small.

In a study of steering, we have to consider the action of ailerons, placed at the extremities of the wings, or of warping the extremities of the wings to produce the same effect. The study of the combined effect of ailerons, or warping, with the vertical rudder, taking account of inertia forces, is easy to make, and though the results are qualitative, there is, in general, no uncertainty with regard to the direction of an effect caused by a given maneuver. Experience with these parts of the aeroplane is so extensive that there is small chance of radical change in future.

It is important to determine whether vertical planes shall be employed at all. Many machines do without them completely; sometimes such planes are replaced by a special configuration of the supporting surfaces, or by an inclination of the wings about a longitudinal axis. These arrangements have not all the virtues claimed for them and many of our best aeroplanes have their wings

not movable about any axis and without vertical planes. On the other hand, the vertical partitions used in certain biplanes serve to diminish the speed and, in consequence, the sustaining power. Such vertical surfaces should be reduced to a minimum, and stability of steering provided by a special conformation of the body and wings, without diminishing their principal function, that of sustentation.

Transverse equilibrium is most unsatisfactory in modern aeroplanes. In calm air, even when turning, the symmetry of the aeroplane prevents any great demand on transverse equilibrium, but in moving air it is of great importance. It is, in general, difficult to fly with the wind, because of insufficient transverse stability. This introduces the idea of stability as distinguished from that of equilibrium. Nearly all writers have confused these terms, and as a result they are now used synonymously everywhere. However, we may state that a system of forces in equilibrium is stable only when an external force, acting to destroy equilibrium, is resisted by the resultant of the system of forces in such a manner as to preserve that equilibrium. With rigid wings, an aeroplane oscillates more as the center of gravity is farther from the center of pressure. When these two centers are near together, as they should be, the stability is nearly zero and quite insufficient to cope with ordinary variations of the wind. With the wings raised as a V, the situation is only a very little better. The only real solution for automatic transverse stability of an aeroplane rests in the flexibility of the wings. Such a solution is not attractive to designers, who wrongly fear to introduce complexity and reduce the solidity and stiffness of their craft. I know from experiment that this is a good solution, but I am not surprised to find it so little accepted. However, there are now two aeroplanes using flexible wings, and a more general use is certain. Flexible wings have a better sustaining power under ordinary conditions, and aeroplanes so equipped will be more manageable, less fatiguing and dangerous to operate, and can be flown in strong and irregular winds. This elasticity of the wings need be given only to the wing tips and after edges. Nothing will prevent any desired wing control, warping, rotation of wings, etc., whether there be one or several articulations or joints.

It has been attempted to replace flexible wings by a system called "la bride elastique," consisting in connecting the rigid wings by

springs to the platform carrying the motor and passengers. A consideration of the forces of inertia shows this system to be unsatisfactory.

Gyroscopic regulators have been proposed to act directly upon equilibrium. This is quite impossible. It is conceivable that a small and delicate gyroscope might be used as a special accessory, which, when actuated by the inclination of the aeroplane, would operate some other device to produce a righting moment. It should be noted, however, that the gyroscopic effect of the propeller has been known to disturb the equilibrium of both aeroplanes and dirigibles, and there is no remedy for it.

Automatic stability is also proposed by the use of a vane towed astern in such a manner as to operate the ailerons in case of a dive. The ailerons are normally controlled by the operator.

Such proposed methods are interesting and should be considered, but with elastic wings, such as were mentioned above and have actually been tried, an aeroplane can be made as easy to operate as a sail boat. And since there is no reason to make a sail boat operate automatically with compass or gyroscope, there seems to be no reason to speculate on how to make an aeroplane direct itself automatically.

BIPLANES AND MONOPLANES.

I have not yet mentioned the two classes of aeroplanes (biplanes and monoplanes) because theoretically there is little difference between them. The biplane type has been developed primarily because of its ease of construction. The braced girder with tension members of wire permits a strong light construction. For the same resisting surface and for the same weight, the sustaining surface is nearly doubled. However, practical tests have shown that the lifting power per square meter of wing area is greater in the monoplane. This is due probably to a decreased resistance and consequent higher speed. But for the same area it hardly seems that the resistance would be any greater if that area were in two parts. The discrepancy probably arises because the aeroplane does not move in a straight line at uniform speed in still air of uniform density.

The displacements of the center of pressure, due to irregularity in the speed of the motor, and variations in the force and direction of the wind, are incessant. Such displacements would exist even if the wind were a regular flow in parallel stream lines—which is never the case—and these displacements of the center of pressure

will not be the same on the two parts, if the surface be in two parts. Consequently, if one surface be in the best position for lifting power for least resistance, the other plane cannot be. The result is an augmentation of resistance, decreased speed, and less sustaining force. The girder construction of a biplane in itself offers considerable resistance, and the great rigidity of such construction forces the wings to act less efficiently than the more elastic wings of a monoplane. Exceptions prove this rule: Certain biplanes, with a rather elastic construction resulting from the use of only two struts, have shown very good sustaining power; while others with a rigid wing support with many struts, have been used to develop great speed on a reduced sustaining surface.

It is not always true that an aeroplane will carry double weight for a doubled area, and that consequently the biplane is the best type in all cases. Experience has shown that for a small weight, the monoplane is best. It is also the most convenient construction for a small machine. Above a certain weight, the truss construction becomes necessary, and the biplane becomes the logical design. What this limiting weight shall be, depends on many considerations. Aside from the strength of the materials of construction and the weight per horse-power of the motor, the design is influenced by the kind of service the aeroplane is expected to give. We could select the smallest motor to sustain any given surface, and the question of construction would determine whether a monoplane or biplane should be used. However, we may wish to realize a greater speed than that required by sustentation alone. Obviously, we must use a larger motor, disregarding any question of economy (weight lifted per horse-power) and will use the lightest construction possible. Since the variations in the wind which cause the increased resistance of the biplane are relatively of small importance at great speeds, this type of aeroplane would seem to have an advantage. Such reasoning holds only for moderate wings, but aeroplanes do not yet fly regularly in high winds. Large racing machines of biplane type are hence logical, even though the monoplane at present seems to hold most of the prizes.

I will show, at another time, that the ordinary variations in the wind have an absolute value which may be compared with the dimensions of an aeroplane. Such irregularities are relatively less important when the aeroplane surfaces are very large, and for a very great spread of wing, the monoplane construction must be abandoned because too heavy.

With an improved wing profile and increased speed, the limiting size of a monoplane is increased. At present, such a limit is about 1000 kilograms, but doubtless this will be doubled in future.

ORTHOPTÈRES.

In the history of aviation, we naturally find many attempts at mechanical flight by imitation of the flight of birds. Beating wings, at the present time, are looked upon with great intolerance by many writers who can see a future only for the aeroplane with screw propeller. They forget the debt we owe to the pioneers of heavier than air flight. Nevertheless, there are a few authorities who believe such an attitude unsound, and who are working to produce a practical "orthoptère"; a flying machine which will sustain itself and advance in air by means of beating wings.

We will now consider the advantages and disadvantages of a machine with beating wings, compared with an aeroplane with fixed planes driven by a screw propeller. First, however, I must point out a common error in the definition and conception of the "orthoptère." It is often said that the wings of a bird strike the air normally on a down stroke so that on the up stroke, by some strange miracle or sleight of hand, the resistance of the air is removed. The bird is supposed, perhaps, to fold his wings and then thrust them out for another down stroke, or to make an up stroke allowing the air to filter through his feathers as through a sieve. From such reasoning it follows that a surface, beating the air normally, has a greater effect than if its action were oblique. But even a superficial examination of a bird shows that it needs no such complicated maneuvering, and that the air never passes through his wing feathers. Also, a horizontal plane, forced to fall vertically, reaches the ground before the same plane falling in an oblique direction. Similarly, a screw propeller, if unable to turn, falls faster than one which is free to turn as it descends. These show the advantages of an oblique attack.

The fact is, that the wings of birds never strike the air normally, but always obliquely, with a large angle of incidence when rising off the ground and with a great expenditure of effort. In steady flight, the angle of incidence becomes but a few degrees, as is the case for all aeroplanes. In the analysis of the flight of birds, the motion of translation resulting from the movement of the wings has been neglected. The axis of reference has been taken on the

bird and moving along with it. But we can see that, when a wing is lowered, there is a forward motion of the whole body, so that the absolute motion of the wing with reference to an axis fixed in space, is in reality both forward and downward in an oblique direction. Just as in the question of equilibrium of aeroplanes, the stupidity of the theorists has led them to consider a static wing motion never found in nature, and their half truths have been incorporated by practical men into flying machines which refused to fly.

An "orthoptère" is a machine in which the wings beat vertically as in the case of a bird, but which strike the air obliquely as in the fixed wings of the aeroplane. The theory of the aeroplane is immediately applicable to the "orthoptère" with certain reservations brought out below.

Near the body of the bird, the beating of its wings has much less amplitude than at the tips, so that the inner part of the wing has little driving power and acts as a sustaining plane, exactly like an aeroplane. The wing tips furnish the motive power and at the same time contribute to sustentation. By reason of the great amplitude of its vibration, the wing tip must have a greater inclination than the rest of the wing. It is probable that in a bird the natural flexibility and elasticity of the wings produce, automatically, a deformation to give the proper variations of the angle of incidence to provide a propulsive component of force, and at the same time a sustaining component.

Even during the up stroke of a wing, the pressure comes on the lower side, and the upward movement is caused by the elasticity of the wing and the forward motion through the air. The great pectoral muscles—so much exaggerated in birds—furnish all the power for flight by their contraction. The role of the scapular or lifting muscles is wholly secondary, and the weak extensor or flexor muscles along the wing are not in use during full flight.

All the movements of the wings of birds, with their reactions upon the air during flight, were carefully studied by Marey thirty-five years ago, and after a careful analysis he proved the extreme simplicity of flight by beating wings.

A mechanical "orthoptère" should be very simple, consisting merely of a body, carrying a motor and passenger, and two flexible wings, having an alternating motion about a single longitudinal bearing. However, there is not yet a successful machine of this type. The first reason for this is the incorrect theory which has led

to fatal mistakes; and the second is the great prejudice among designers against movable jointed wings, which, they fear, will be weak, if they are flexible. Finally, there is no motor adapted to the control of the wings.

These objections may be overcome in future. The motion is a simple reciprocation in one plane; the construction is not difficult, and with a single articulation should not be heavy; flexibility is no longer a problem, for aeroplanes are now in use with flexible wings which are both light and strong. The question of a motor presents greater difficulty. The trouble comes from the slow speed of the wings, 20 or 30 strokes a minutes for a machine of 200 or 500 kilograms. A light motor must run at high speed to develop its power with a low torque. There must then be some reducing gear, having considerable weight. Yet some aeroplanes have found an advantage in having a reducing gear, and the extra weight may be balanced by a gain in efficiency of the machine as a whole.

Another objection is made to the "orthoptère" on the ground that a reciprocation is inferior to a continuous motion. This is largely a matter of opinion. Only in turbines and electric motors can we get a continuous rotation without starting from a reciprocating motion. In such a medium as air, a slow reciprocating motion may be much more advantageous than the continuous rotative motion of a high-speed screw propeller. Present-day aeroplanes, running their propellers at 1000 to 1500 revolutions per minute, give a tip speed of over 200 meters per second. This figure will no doubt be exceeded by the high-speed aeroplanes predicted for the future. A high speed is, of course, favorable to sustentation and to the action of a propeller blade, but there is obviously a limit. This limit is already passed in the case of screw propellers, for experiments show a gain in efficiency with larger and slower propellers. This is not a general rule, and it will be mentioned later in the discussion of propellers. In an "orthoptère," the speed of wing tip is about one-third the speed of blade tip in an aeroplane running at the same velocity. For very high speed, then, the "orthoptère" would have an advantage.

The principal argument in favor of the "orthoptère" is its compactness. The wing, being active, has greater sustaining effect than when acting passively, as in an aeroplane. This makes the former especially adapted for small machines for short trips with one or two passengers. Such small machines are the easiest to

build, and it is possible that some day there will be "orthoptères." In addition this type is easily stored, and has special facility for landing or rising from restricted spaces. It is possible that such machines may become very common, and for that reason I have included this discussion. The special advantages must not be exaggerated, and it must not be assumed that an "orthoptère" can rise without a space before it. It seems natural to think that with flapping wings, a machine could rise vertically from the ground, but the impossibility of such a feat is pointed out above.

I believe there has been only one successful "orthoptère." That one was a model made by Tissandier thirty years ago, but at present such flight, though interesting, is hardly in an experimental stage.

It is interesting to note that small birds fly with flapping wings, while heavy birds fly in this manner very little, showing a marked preference for soaring ("vol plane"). There is no bird heavier than 10 kilograms that can fly with flapping wings for any considerable time. Of course, with tireless mechanical motors more powerful than the natural ones, the limit on weight will be much greater. This observation serves to confirm my opinion that the aero-motorcycle of the future will fly with flapping wings.

HELICOPTERS.

A class of machines having more supporters than the preceding is the helicopter in which both the propulsive and sustaining forces are given by screw propellers. The system has the following advantages: Direct use of rotational movement, ability to rise or land in a vertical line, ability to hover over any given point. The machine consists of a car with motor and passengers, having one or more propellers with vertical axes to give sustentation, and one or more propellers with horizontal axes for propulsion. This combination of propellers may be replaced by a group in an intermediate plane which will give the same components.

All this demands great weight and complication of machinery, and though a possible solution, is not a good one, for the screws with vertical axes have only a small sustaining power, even under favorable conditions. There is an absolute limit placed upon them by the fact that the weight of a propeller will increase with the cube of a diameter, if it exerts no force, but at a greater rate when a reaction is met. On the other hand, the reaction or thrust of the propeller increases much more slowly than the cube.

Toy helicopters, launched by springs, whose power is out of all proportion to the weight lifted, are most successful; but full-sized machines have recently given most discouraging results. They were with great difficulty raised a small distance, and sustained only a little while. Calculation from the observed efficiency of the screws seemed to prove that flight was possible. But the fact was overlooked that the lifting screws were turning near the ground, so that the discharged streams of air could not easily escape. It is reasonable to suspect that the thrust, under such conditions, is exaggerated, and there is small hope of ever seeing a helicopter stationary in the air. In such a case, the great screws, turning at high speed, would produce a downward current in the air, in which it would be very difficult to sustain a body of any size.

Another practical difficulty rests in the fact that, whether with one set of screws or two sets at right angles, when the machine moves ahead the screws work on oblique streams of air. The result is an uneven action and shock on a blade at every revolution. The efficiency is much reduced, and a heavier blade construction is required.

Therefore, in spite of the apparent simplicity of the helicopter, I believe it can never be successfully built. It is interesting to show that the flight of insects is similar to the helicopters, and it is easy to propose a large machine to imitate this natural flight. But the theory of the screw propeller shows that such an application is valuable only with a very small weight. Observation and theory agree in condemning the helicopter of any weight above a few kilograms, and at the same time, recommend it for little flying toys.

SCREW PROPELLERS FOR AEROPLANES.

After helicopters, it is natural to take up the subject of screw propellers in general. Surprising as it may seem, the theory of the propeller is not well developed in spite of the learned volumes written about it. The design of practical propellers to meet definite requirements is entirely empirical. This is the result of the barrenness of the methods of pure science. The mathematicians have a tendency to consider the entire arsenal of mathematical processes as a science complete in its abstraction, and with little reference to natural phenomena, while, at the same time, physicists often tend to avoid mathematical analysis. The result is that this splendid instrument, mathematics, though only a tool, finds few hands

capable of making effective and practical use of it. In order to apply the mathematical treatment, certain assumptions are first made, restricting the phenomena to a special case more or less impossible. The results are then translated into formulas, which, once established, permit a full mathematical development—integration, exterpolation, and all the flights of a spirit embarked in the realms of serene abstraction. In the meantime, the original assumptions have been forgotten, or ignored, and the precise conclusions, reached with such brilliant effort, lead to bitter disappointment when applied to real conditions which have never been analyzed.

In the matter of the propeller, it is surprising to note the restrictions made to facilitate the use of mathematics. Formulas and curves so developed have no practical application. The experimental method has, therefore, been turned to, but in order that our experiments may be fruitful, there should be a fair working theory of the propeller to serve as guide. Such theory, even if very approximate, will be corrected and further developed by the experimental work. Curves of thrust and efficiency have been made for many propellers, but these are isolated examples not connected by any law. A rigid analysis of the phenomenon should have been made first, for it is probably the resultant of many independent phenomena superposed. The problem becomes, therefore, one with many independent variables, and can hardly be expressed in a single general formula. The common theory cannot bring out the effect of such variables as the angle of slip, profile of the blade, speed already acquired by the aeroplane, etc. The problem is similar to that of the wing surfaces, and the final result will only be reached by the experimental method. But it will not be necessary, when one factor has been determined, to apply to it all the flights of mathematics. What we need is simply a penetrating analysis, certainly difficult, but demanding only logical reasoning to separate out as many as possible of the elements of this complex action. We hope that soon our aerodynamic laboratories will give us a practical theory of the propeller.

In the meantime, we must not make the mistake of considering the propeller apart from the aeroplane on which it will be used. It means nothing to say that a certain propeller gives a certain thrust, and we must not base our prediction of its performance on trials made with the propeller alone, thrusting against a fixed point. The

present theory, though incomplete, is an aid to understanding the action of the propeller, but experimental work must proceed with full-sized propellers in flight, or under identical service conditions.

The most striking feature of aeroplane propellers is their great speed, 20 to 30 revolutions per second, giving a tip speed of 150 to 200 meters per second. Such excessive speed is demanded by motor design, and operates to reduce the number of blades and the pitch, while friction is increased as well as blades stressed. It would help designers if the theory could give the limit on speed, or could prescribe the conditions to meet any given speed. It has seemed of advantage to reduce speed by some reduction device on dirigibles, and probably most aeroplanes except the smaller racing machines will find an advantage in such reduction of propeller speed. Some of the larger aeroplanes in which a reduction is made have proved very satisfactory. The gain comes from a larger number of blades, larger diameter, or a larger number of propellers driving the machine, and in general an increased propulsive area. It is obvious that, for good efficiency, there must be a lower limit on this area.

A most important effect of the high-speed propellers is the gyroscopic action, which is considerable in spite of light construction. This effect may be beneficial in contributing to longitudinal and lateral equilibrium of an aeroplane or dirigible, but at the same time, it is blamed for serious accidents. The propeller tends to remain in its plane of rotation and to resist the action of the rudder. On a sudden turn, the shaft and blades are abnormally stressed. Rupture comes at a time when the equilibrium is not steady, and a fall is probable. There have already been several catastrophes due to propeller failure.

Another cause of fractured shafting is claimed to be vibration. The shaft and propeller will vibrate with a natural period, depending on the dimensions and the method of supporting. If this period synchronizes with the impulses of the motor, the resonance established will increase the amplitude of vibration to the breaking point.

Also, in flight, the thrust is not in line with the axis of the shaft. The latter is usually inclined with respect to the wings by an angle equal to the angle of incidence of the air on the wings in steady flight. The effect is that the propeller has a vertical inclination to the stream of air in which it works, and the uneven action of the blades will produce a shock on each blade at every revolution. This

point was brought out in discussing helicopters. Ordinarily the angle of inclination is small and the effect can be neglected. However, the vibration may be added to that described above to produce disagreeable oscillation.

Such points must be considered with reference to the advantage of light construction and a low factor of safety. Vibration must be reduced, and sharp changes of direction and altitude avoided. The acrobatic feats of a certain class of aviators should be forbidden unless their machines are especially designed for that purpose.

For security it would appear of advantage to have more than one propeller, but if disposed laterally, the stopping of one might destroy equilibrium. It is possible to avoid this difficulty, and machines with two screws have been made, but driven from a single motor.

Two motors would afford security against the failure of motive power. Such an installation is quite possible, and it could be arranged to drive two propellers by either motor or by both. There would then be two independent propulsive units, one in the rear of the other.

JET PROPULSION.

It has been predicted that, in the not far distant future, velocities as high as 300 kilometers per hour will be attained. This is, of course, Utopian, but were such speed to be realized, the screw propeller would be inadequate. A tip speed of 500 meters per second would be required, and no known method of construction could make a blade of reasonable weight sufficiently strong.

A fluid passing through an orifice from a tank, where the pressure is high, to the atmosphere, may attain a velocity as high as 1000 meters per second. If the difference of pressure could be maintained, the reaction of the jet might be utilized. It is proposed to carry some machine to generate a fluid at high pressure and to discharge it downward and to the rear to create forces of sustentation and propulsion. Such a discharge should be by puffs at short intervals, so that the outside air would not be set in motion creating a current opposing the aeroplane.

It is not difficult to find serious objections to such a scheme. Even at the extreme speeds spoken of so lightly, the mechanical efficiency of the apparatus would be very low, and for present-day speeds, would be practically zero.

Such motive power would make rising and landing a most violent operation, requiring buffer springs and an extremely rigid and heavy construction.

It is hardly probable that a machine will ever fly with the propulsion of a jet.

AEROPLANE MOTORS.

The light motor made aviation possible, and the effort is still being made further to lighten it in order to increase the capacity for carrying load, and, consequently, the radius of action. Nevertheless, extreme lightness must not be attained at the expense of reliability and endurance. A weight per horsepower of 3, 5, or even 10 kilograms is permissible at present, and with the probable increased efficiency to be expected, the present type of motor should be very satisfactory.

Aeroplane motors work under no special conditions, and can apply any improvements made on automobile motors, or explosion motors in general. There have been doubts as to the performance of aeroplane motors in the rarified air of high altitudes, though automobiles find little difficulty in climbing mountain passes of great height about sea level. A proper adjustment of the carburetor and the ignition should provide for any altitude changes. A considerable loss in power is not a serious drawback, for aeroplanes in practice are always greatly overpowered in order to meet strong air currents or to climb quickly to 1000 or 2000 meters altitude. And if the more rarified air at a great height gives less sustaining effect, the resistance is also less and for a given power the speed should be much increased.

Cooling is the most serious problem in motor design, and increases in difficulty with increase in power. A decrease in pounds per horse-power is prevented by this difficulty of getting adequate cooling without the use of auxiliary apparatus.

However, the last word in motors has not been heard yet, and perhaps, very soon, we shall have an internal combustion turbine, which will be lighter and less subject to vibration than the piston motor.

The future of aviation is much concerned by the possibility of installing a propulsive system of several motors and propellers in such a manner that failure of one motor will not affect the others. In such a case, there would be reasonable security against the risk of a forced descent, a risk least attractive for over water flying.

The solution is fairly simple, but demands some sort of transmission device The claim for reduced propeller speed also required such transmission as shown above, and allows high-speed motors of reduced weight.

Variable speed is hardly of advantage in an aeroplane motor, except for a few moments before landing. Variable speed can only be given at the expense of reliability and endurance and considerable complication must be introduced. This complication can well be avoided in an aeroplane motor, which should have in practice a single operating condition, corresponding to the most favorable speed and load of the aeroplane.

LAUNCHING—LANDING.

Except for a helicopter, speed is necessary before a machine can sustain itself in the air. Consequently, before taking flight a velocity must be imparted by some launching maneuver.

Wheels on the aeroplane are an extra weight of no advantage in flight, but nevertheless they render the machine entirely independent of a fixed launching or landing place. An aeroplane can then rise from any place where a clear field ahead can be found, and the equipment need not be very heavy for a machine of from 500 to 1000 kilograms.

Launching by means of a spring, catapult or similar device has the great disadvantage of making the machine dependent upon a fixed installation, to which it must return before making another flight. The machine itself could, of course, be made lighter by doing away with a carriage. The disadvantage of fixed stations of arrival and departure would have less weight in special cases. For instance, the great passenger aeroplanes of the future will require such stations, just as we now need railroad stations and wharves. For small aeroplanes to be carried aboard ship, a special launching or landing arrangement would not be a serious inconvenience.

Another method is to allow the aeroplane to slide down inclined rails until a sufficient speed is attained. In a similar manner birds often take flight from an elevated position.

The speed necessary in launching is obviously with reference to the air, and if at the start, the wind has a velocity with reference to the aeroplane, the velocity to be acquired may be less than for rising in still air. Consequently, launching against the wind requires less speed and less space, and a similar advantage is afforded

in landing. Launching will be obviously easier if the aeroplane has a great excess of power, but in order to benefit by this excess there must be movable horizontal surfaces, such as horizontal rudders, large ailerons, or the wings themselves movable. At the start, the angle of incidence is increased to increase the sustaining force, and when well under way, the angle is decreased to increase speed and prevent the aeroplane rising higher.

Most careful consideration must be given to the air currents produced by any platform for launching or landing. The question comes up at once when aeroplanes are to be launched from or to land upon a ship's deck. It will generally be possible to facilitate such maneuvers by taking advantage of conditions.

Landing appears simpler than rising, for it is always easier to check a velocity than to impart it. But the operation is rather ticklish, and requires shock absorbing devices. To alight with precision upon a small platform, the wings should be movable, or special braking surfaces provided on the aeroplane.

AVIATION IN THE NAVY.

Aeroplanes are universally considered to have great value as instruments of sport, and it is admitted that in special cases they might be of real service to an army in the field. But with a few exceptions, it is denied that the navy has or ever will have any use for them. It seems a shocking blunder to spend several hundred thousand francs (in a budget of 400 million) on air craft that might well be spent on battleships. The rôle that is claimed for them is also that of wireless telegraphy, infinitely more sure and rapid.

Therefore, before commencing an argument that my brother officers may follow with considerable distrust, I wish to make my position plain. I agree that the navy should be made up of ships; as many ships as possible for the money available. But I also believe that these ships should be of the type to assure victory in battle—battleships—"capital ships." Cruisers, scouts, destroyers, torpedo-boats, and submarines are all auxiliary to the battle fleet. Though such auxiliaries are necessary, their importance must not be exaggerated to the point of spending on them half, or more than half, of our appropriation, as has recently been done. The navy has suffered from a craze for flotillas of useless and costly auxiliaries of every type, whose only reason for existence is a supposed economy.

A short time ago the true state of affairs was realized and the construction of torpedo-boats and cruisers was discontinued. At the same time, it was not forgotten that a navy cannot be composed of battleships alone. Though no torpedo-boats are built, there are many submarines, and in place of cruisers we now depend on powerful armored cruisers to make reconnaissance, as well as to take a place in the line of battle. And there also has been developed scouting tactics for the battleships themselves. Great and costly armored cruisers have a short life, and scouts are proposed. Destroyers are made larger and larger with the hope of using them as ocean scouts.

It is absolutely necessary for an admiral, as for a general, to be well informed regarding his enemy, before he can act with confidence and precision. Wireless telegraphy has rendered the *transmission* of intelligence prompt, sure and economical, but, in addition, there must always be agents to *collect* information, as fully as possible, at the greatest distance possible, and as often as possible. With the great mobility of modern fleets, the setting of the chess board of strategy and tactics is constantly changing.

Aeroplanes are especially adapted for this important service by their ability to mount rapidly to 1000 meters altitude, to maintain a speed of 50 or 60 knots, and to observe without danger to themselves. They can be fitted with wireless telegraph apparatus of small weight, and due to their cheapness, we can have great numbers of them at an expenditure of but one or two per cent of the total appropriation, instead of the usual 30 to 50 per cent.

Considerations of economy, first urged against providing aeroplanes, will end by forcing aeroplanes upon the navy and will hasten their development and application to naval uses.

But aeroplanes need not only be scouts. They are especially valuable in detecting a submerged submarine, due to the fact that, from a great height, a man can see far beneath the surface of the water. The recent progress in the effectiveness of the submarine has created a most dangerous risk for a fleet, even when at sea, against which no means of defence has been devised. Although aeroplanes would not be an absolute security against submarine attack, they are nevertheless the best defence available.

Also, the aeroplane could be employed to find out the position of submerged mines, or floating mines, and to guide a squadron through a clear channel between such dangers.

It is probable that the aeroplane could be of great service for fire control at extreme ranges in observing the fall of shell.

But aside from the function of an observer, cannot the aeroplane serve as a weapon of direct offence? It could carry powerful explosive enclosed in a resisting envelope like a shell for a gun. An aeroplane, detailed to watch for submarines, would carry several such bombs, which could be dropped near or upon a detached submarine. The explosion could be arranged to occur at a given depth, or against the side of the submarine, and the injury to the submarine would sink it, or force it to come to the surface to surrender.

Similarly, bombs dropped into a mine field would doubtless serve effectively as counter mines and clear a channel for a squadron.

Fire bombs for lighting up a field of battle are very heavy and expensive when shot from guns, but if to be carried up in an aeroplane, they could be made very light. Their effectiveness would also be enormously increased because such bombs could be dropped from an aeroplane over the place to be lighted, attached to a small parachute, so that the light would last a long time. In this way, aeroplanes could co-operate with a torpedo attack upon a squadron, while at the same time the defenders could use the same means as a defence against the torpedo-boats in conjunction with their defending destroyers.

The number of ways an aeroplane can be of service seems unlimited in such special cases as the siege or defence of a fortress, combined operations of ships and troops, landing a force, etc.

I shall not attempt to look far ahead to the day when great aeroplanes will transport 20 or 50 men and several tons of armament, for by that time the art of war by land and sea will be so revolutionized that our present principles may not apply, and deductions based thereon will be false.

However, let us return to the actual and immediate possibility of aviation in the navy.

THE NAVAL AEROPLANE.

The characteristics of the naval aeroplane are determined by the function it is designed to exercise.

If the rôle of an aeroplane is confined to that of watching the entrance to a harbor or roadstead, it may be a very small machine. Only one observer beside the pilot need be carried, and the supply of oil and gasolene should be enough for a maximum duration of flight of two hours. Only a small weight of explosive would be

taken aloft. Floats must be provided of volume sufficient to prevent sinking in case the aeroplane were forced by motor trouble to land on the water. In all other respects, the aeroplane would be of the ordinary type.

If the aeroplane of great size and endurance is soon developed, such a type could be used to serve a squadron within a hundred miles of the coast. A great radius of action would be required, and launching and landing would always be on shore. However, to prevent loss in case of a forced descent at sea, floats would be provided as in the type above, and arrangements made so that the aeroplane could be hoisted aboard ship without damage and brought ashore again.

But it is evidently of great advantage to have the aeroplane stationed on a ship from which it can be launched, and upon which it can land. For such a purpose a garage vessel has been proposed to accompany the fleet and shelter a half dozen aerial scouts. But in order to be of any real value such a ship must be a great vessel with enormous deck space and with a speed equal to that of the fleet. The probable cost of 15,000,000 francs would hardly be justified, even if the number of cruisers were reduced. Besides, such expense is not necessary.

Modern battleships of the largest size can easily provide space for the launching and landing of aeroplanes without interference with essential features of design nor great expense. In addition an aeroplane can easily be taken apart and stowed below if it be desired to keep it aboard during action—this is hardly probable, however. At any rate, the problem of rising from a ship's deck and landing upon it is now being studied by able minds, and we can expect a practical solution at any time.

The naval aeroplane looked on with most favor by all [except sailors] is the hydro-aeroplane fitted to rest on the surface of the water and take flight directly from it. Such machines are useful only in absolutely still water, and with even a very moderate sea trouble would be experienced. To float on the water is no great advantage, except perhaps for a great aeroplane acting independently of a ship and attempting to make a protracted cruise. In such a case, the aeroplane might desire to rest on the water at intervals. However, such a utilization of an aeroplane will not come in the near future nor for the aeroplanes of moderate size.

It is now possible to define the qualities of an aeroplane to suit general considerations. When a demand is made for a definite

service, I have no doubt a number of types will be offered, all more or less fulfilling the conditions. A careful selection after trials will then establish their relative merit. But the designers need some sort of guide, and it is expected of the navy to write its own specifications. In the present status of the aeroplane, I believe the question should be brought up in this manner:

A competition to be held by the Navy Department for a naval aeroplane.

1. A naval aeroplane shall be defined to include any type of aeroplane which by means of special floats, water-tight body, or even thick wings serving as floats, has the ability to float on a moderate sea (wave height one meter), in a moderate breeze (10 to 12 meters), for several hours without injury to passengers or machinery. The motor to be of such construction that, after several hours in the above position, it can be overhauled and put in operation in a few minutes

It seems that the monoplane would be preferred, but any type might enter the competition, provided it met the conditions specified.

2. Any machine presented to be so constructed that it can readily be hoisted from the water and landed on a ship's deck by the ship's crane.

Such an arrangement might be, for example, a strong ring secured to the body of the aeroplane in such a manner that the whole machine can be suspended from it without danger to passengers or to the machine itself. It will not be required that an aeroplane take flight from the water. If such a machine be submitted, it must meet all the other conditions of the competition.

3. A naval aeroplane must be able to take flight from or land upon the shore under ordinary conditions.

4. Speed is not specified, but other conditions equal, speed will be considered an advantage.

5. Details of construction are not satisfied, but preference will be given to machines that are the simplest to handle and to stow aboard ship. It is considered an advantage if a machine separates easily into parts convenient for stowage or transport.

6. The naval aeroplane should have great stability and good maneuvering qualities.

7. With reference to power and endurance two classes will be recognized:

a. An aeroplane *scout* shall carry two passengers, a pilot and an observer for 3 hours, with an extra weight of 50 kilograms, giving a total weight carried of 200 kilograms, exclusive of necessary oil and gasolene for the motor. With such loading, the aeroplane must attain an altitude of 1000 meters in 20 minutes.

b. An aeroplane *cruiser* shall carry three passengers, a pilot, a mechanic and an observer, for at least five hours, with an extra load of 100 kilograms, giving a total weight carried of 325 kilograms, exclusive of necessary oil

and gasolene for the motor. With such loading, the aeroplane must attain an altitude of 1000 meters in 20 minutes. In flight, the observer, pilot and mechanic may alternate in driving the machine. Employment of two motors, propeller groups which function separately or together, is considered an advantage, provided one motor alone has power enough to sustain the aeroplane, and that there is no dangerous shift of equilibrium if one motor stops suddenly.

8. The Navy Department will furnish a plan of the facilities for launching from a ship and landing arrangements in order that designers may adopt their aeroplanes to service conditions. Designers may suggest any changes they see fit, but are in no way to be considered responsible for the operation of such appliances provided by the department, as they are for the sole use of the department pilots.

USE OF DIRIGIBLES AT SEA.

The dirigible balloon is thought by many to be the type best suited for naval use.

The balloon has a few advantages and many disadvantages. It is considered an advantage to be able to hover over a fixed point on the ground. This is of course possible for a balloon only when the velocity of the wind is less than the rated speed of the balloon. The balloon is in less danger from failure of motive power than an aeroplane, but over water this advantage has less weight than ordinarily.

The disadvantages of the dirigible are many and serious. The first is the great expense, including first cost, housing, equipment, and landing facilities. The life is short and precarious, even when frequently overhauled. The low speed (lower than that of the aeroplane) is a disadvantage and prevents flight in winds that an aeroplane can successfully cope with. The dirigible maneuvers very badly both on the ground and in the air, and can reach an elevated position only very slowly. By reason of their immense size, they present a most vulnerable target to hostile ships or even aeroplanes. They are also greatly affected by variations in temperature, humidity, solar radiation—elements having almost no effect on the aeroplane. A dirigible cannot in any way be carried by a ship at sea, so that their use is prohibited at any distance from shore.

I believe that the dirigible balloon will only be used by the navy for observations in the immediate vicinity of a port.

Experiments should be undertaken to determine the possibility of detecting submarine mines from an aeroplane. But in the meantime such work can better be done with a dirigible, moving slowly over the mine field at a sufficient height to give a good view below

the surface of the water, and still low enough to make use of a guide rope if necessary. Such observations would have to be made in a place covered by the guns of the shore batteries, and at a time chosen when the wind is not high. An auto-balloon of moderate size—1500 to 2500 cubic meters—would be the best type to use.

It is, therefore, reasonable to expect that at every naval base there will be one or more hangars with two or three small dirigibles each. But it would be false economy to attempt to enlarge the sphere of usefulness of such dirigibles by increasing their displacement. Scouting must be left to the aeroplanes.

CONCLUSION.

I stated above that the object of this paper is to clear away a certain amount of fog, and to create in the navy a favorable attitude toward naval aeronautics. For this reason I have attempted to show the different aspects of the case, rather than to solve the many problems that are presented. I have omitted all intricate technical discussion, and the use of figures and formulæ. The flight of birds is only mentioned, and no analysis is made of soaring without power, at present most useful and interesting. And I hope that what has been written or the ideas suggested by reading this paper, will destroy much hostility toward aviation, and that the tests which the Navy Department is about to commence will be watched with interest if not with sympathy. This is the only ambition I have for this modest work.

In the development of any new science or industry, it is necessary to wait for the progress of private enterprise. But in this case, progress is of such vital importance to the state, for the army, navy, postal service, etc., that the Aerodynamic Institute should be generously subsidized. Funds should be granted to conduct a long series of methodical tests on full-sized machines, and pilots and observers should be supplied by attaching to the institute officers and engineers who desire to specialize in aeronautics. It will not be a question of allowing inventors to develop their ideas at the expense of the state, but to create something similar to the experimental model basins used by all navies. These basins have given out such precise and valuable experimental data, that sometimes the saving in power for a single battleship is worth as much as the first cost of the basin itself.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

SHORE PATROL DUTY IN THE NAVY.

By MIDSHIPMAN S. R. CANINE, U. S. Navy.

Having done patrol duty a number of times, and for as much as two weeks at a time, I feel justified in expressing my views regarding this important duty.

My views are those of one who has always been a junior patrol officer, and of one who has always been in close touch with the men on liberty and with the patrol. I do not wish to criticise, but to state my ideas on patrol duty in general and possibly give a few helpful hints to the younger officers who have never had this duty. My experience with this duty has been in foreign places entirely, and is as follows: Two weeks continuous duty each in Shanghai, Panama, Bahia Blanca, Argentine Republic, one week in Manila, and day's duty in Honolulu, and other places.

When ordered on patrol duty for the first time, one usually asks the question "What am I to do and what system is to be used in handling the patrol?" There is no fixed rule. It all depends upon the city to be patrolled and the number of men given you for duty. Each city is a problem to be worked by the officers on duty.

Arrangements are made with the city officials for sending liberty parties and a patrol ashore and a place is assigned by them as headquarters for the patrol. This varies from a room in some old deserted building to quarters in the fire or police station. The officers can either take quarters with the men or go to some nearby hotel. It is necessary to keep in close touch with the patrol headquarters.

The patrol should be carefully instructed concerning the fleet get located in the assigned quarters and for the officers to get the patrol posted.

It is well for the patrol officers to be on intimate terms with the chief of police and to ask his coöperation. Explain to him that you have the patrol there to assist his force and that in minor cases where a bluejacket is arrested it is best that the man be

turned over to the ship's patrol; that the man will surely be punished on board ship. The chief of police, or any of the police force, can best tell you where trouble is most likely to brew and the limits of these places. The patrol can then be divided into watches according to the number of places to be patrolled, and the first watch posted. On posting the first patrol it is well to take the whole patrol force along that they may be informed as to the places they are to patrol and that they may know the way to their beats. Good reliable men may be allowed to relieve their men without being posted by an officer. If possible, detail the patrol in pairs. They are much more efficient this way. One man is naturally timid about exerting his authority where there is trouble, while if he knows that he has a good man to help him, he will tackle any trouble. Then again, two men will be needed if any are needed. Liberty men from one ship will sometimes band together and impose upon a weak patrol if he be not from their ship.

In some places it will not be necessary to keep the patrol on duty all night. At least it may be diminished and some places will not need patrolling at all. Trouble usually is more apt to occur between the hours of nine and eleven p. m. After this hour the bluejackets begin to retire or return to their ships. I have found that trouble often occurs in the "red light district" in the early morning when the men are leaving to go home. After midnight one or two men can patrol what several men were required to patrol earlier in the night. Many times requests will be made by managers of some theatres or moving picture shows or similar concerns for a patrol and I have found that the patrol has done much good at these places. A disorderly bluejacket in a public place of this kind does much toward lowering our navy in the eyes of the foreigner. A patrol at these places who does his duty creates the best possible impression.

The patrol off watch should be kept at headquarters, for calls frequently come in from places where there is no patrol. Where the patrol is permanent, and there are enough men to allow it, I believe that the men should be given liberty.

Personally I believe in a permanent patrol of picked men. Where the patrol is shifted from day to day, the efficiency of the patrol is greatly reduced. The men do not get on to the swing of things and most of the time is taken up in instructing the patrol, relieving them and posting them. Men who have the duty for all

time learn the system thoroughly and do their work efficiently. They learn the haunts of the men where trouble is most likely to occur and the times that certain places should be watched. They are also capable of relieving each other and of being sent to unpatrolled places without a guide. Where the men are shifted from day to day, it is quite impossible always to have thoroughly reliable men. The best men possible should be detailed on this duty. Sometimes patrol duty is looked upon as something unimportant and men are sent on this duty that are worse than useless. This creates a bad impression. They should be men that have as much of a military bearing as possible and men that are strictly duty men. It is a disgrace to our men to have a patrol on duty that will stop to joke with "the girls," and be otherwise inattentive to duty. An efficient patrol creates in foreign places the highest respect for our navy and our country.

Often the number of patrol at your disposal is insufficient. The only thing to do is to put them in the most dangerous places. In a large place no attempt can be made, or should be made to patrol the entire city. The most respectable places do not need patrolling. It is only the tough places and the cheap saloons.

The patrol should be given all reasonable attention while it is ashore. A means of returning men to their ships should be arranged and carried out. When the ship or ships are anchored far from a city and large parties of men are sent ashore to attend some function, special care should be taken to see that the men are provided a means of returning to their ships that night and not left in the city moneyless as they sometimes have been.

A discouraging thing to the patrol officer is the failure to keep in touch with the ships and to have them coöperate with him. Each ship should send to the patrol officer each day the number of men sent ashore, the time that liberty expires, and the names of the absentees. The uniform should be given the patrol officer, he should have a boat schedule from each ship, and each ship should keep him informed of all changes.

Absentees should be searched for and each patrol should know the names of the absentees. Men breaking liberty often live ashore at some hotel or low place or in rooms attached to some saloon where the manager is "a friend of the boys." Of course they go to other places, but they frequent these mostly as they receive a welcome there and the living is cheap.

The patrol should be carefully instructed concerning the fleet regulations regarding patrol duty and, if any member be found breaking them, he should be arrested, and returned to his ship.

A patrol should be detailed from the ship to go on all liberty boats. He not only keeps order on the boat, but men being returned to their ships can be placed under his charge and thus keep the shore patrol intact.

One great trouble in foreign places is with the hack driver or the 'rickshaw man. They often try to overcharge the men, especially if they are not perfectly sober, and if the men (never but a very few) are mean about paying the proper fees. Do not unhold the driver without good cause, for, knowing that he can come to you with his troubles, he will bother you continually, telling lies about not being paid. The patrol officer is charged with the conduct of the men ashore and he should take care to see that they are given fair treatment in all places. When a bluejacket is arrested by the local police he should inquire into the case and where proper try to have the man sent back to the ship where his punishment will serve as a lesson to the men.

The value of our patrol is greater than many people will consider. The mere presence of our patrol will prevent trouble where the local police would or could not have prevented it. A bluejacket knows that if he is arrested by a patrol that he is sure to receive punishment and that it will be put on his record, while, if he is arrested by the local police, he may have to pay only a small fine or be confined for a short time. They also know that they must behave properly on the streets or be sent back to their ships. A bluejacket dreads losing his liberty in a foreign port and this serves to keep him good when there is a patrol ashore.

Patrol duty is instructive to the officers in that they are continually meeting people of all classes and nationalities and they are frequently called upon to handle cases that require tact and diplomacy.

The beach patrol should always be separate from the shore patrol and this patrol can be shifted as often as desirable and without harm.

There are many little points connected with patrol duty that might be given. They are easily learned, however, and it is not necessary to state them. The main thing is a permanent patrol of both officers and men, and both must be of the best.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

DIESEL ENGINES FOR NAVAL PURPOSES.

By LIEUTENANT A. K. ATKINS, U. S. Navy.

The application of the internal combustion engine to marine use has been an attractive problem from the time when the engine became a successful machine. In the following notes an endeavor has been made to set forth accomplished, dependable facts, and to preclude fanciful ideas or theories. The comparison drawn is based upon an actual experience with steam machinery, realizing that the reciprocating steam engine is very near the top of its curve as far as efficiency and reliability is concerned. Without much doubt the internal combustion engine, as exemplified by the Diesel type, is the power that will be reckoned with in our service at no far distant date, and we are on the verge of an economic development in the use of fuels and machinery that is very little realized. In this country we are so extravagant as a nation, and our present incentive for economy of power is so slight, that we are years behind Europe in the development and use of means for the conservation of our natural resources. On the continent of Europe they have been gaining invaluable experience with the Diesel engine for the past eighteen years, and have placed it upon such a utilitarian basis that we will soon be forced from our lethargy to a lively interest in the matter and will find ourselves confronted by the steep hill of experience to be surmounted before we can apply the engine to our own problems. It may be that the navy will be required to force progress by its particular demands for increased radius of its heavy ships, increased power on a limited tonnage, and other features of a military nature, to keep pace with foreign progress.

For the internal combustion engine to replace the steam engine for naval purposes, taking the two types solely as machinery plants in themselves and disregarding the advantages or disadvantages that will naturally follow in the wake of either, it must, in doing

the same work: (1) be more economical in space and weight per effective horse power: (2) be more economical in fuel consumption (for naval use this relates to increased radius on the same weight of fuel, rather than on the *cost* of the fuel): (3) develop its horse power on relatively low speeds of revolution so as to obtain high propeller efficiency: (4) be reliable in operation and as capable of minute speed regulation as the prime mover of the steam plant.

The gas-producer plant, in its present form, fails in economy of space and weight, in reliability, and at low speeds is not markedly economical over our present steam installations; its stand-by losses are also equally as great. From this discussion, then, on the basis of the foregoing indictments, the gas-producer will be dismissed.

The first note we have of the Diesel engine is in Dr. Rudolph Diesel's paper on the subject in 1892, and his idea at that time was to develop an engine to operate on the Carnot cycle, and an engine to burn coal in the working cylinder. Practical engineers recognized at once that it would not be possible to attain that which Dr. Diesel sought, and for a commerical engine it would be necessary to carry away some of the heat of combustion; also, that the unburned residue of the solid fuel could not be removed from the cylinder. Accordingly the cylinders were water-jacketed, pistons cooled, and heavy oil adopted as the fuel. This condition of things will, no doubt, remain unchanged.

The Diesel engine is essentially a slow combustion or a constant pressure motor; that is, heat is produced during an appreciable time while doing work, the volume of the working medium changing. The ignition and combustion of the fuel are produced by the compression of air to a high degree in the working cylinder. Pure air is drawn into the cylinder and compressed to about seven or eight per cent of the cylinder volume, or to about 500 pounds to the square inch; the air in this state is incandescent and at an approximate temperature of 1000 degrees Fahrenheit. This, the first process of the cycle, Dr. Diesel expected to carry out adiabatically, with an insulated cylinder, up to about 3000 pounds per square inch. The next process is the admission of the fuel, which is ignited by the compression temperature. The fuel is admitted at about the top center, and admission continues until the stroke has progressed ten or twelve per cent. Heat is produced doing work

during this admission as the volume is changing, and the pressure in the cylinder remains practically constant. This process in the original idea was to be carried out isothermally, and it is this production of heat during an appreciable time at constant pressure that gives the name " constant pressure " cycle in contradistinction to the " constant volume " cycle upon which gasoline or explosion motors work; and where the heat is produced instantaneously by the explosion of the fuel mixture by an ignition spark. The third heat process of the Diesel cycle is the expansion of the heated medium throughout the remainder of the stroke after the fuel admission valve has closed. This process was to have been an adiabatic expansion in the original cycle. The fourth process is the discharge of the combustion products and the recharge of the cylinder with pure fresh air. This was to have been an isothermal process. The necessity of cooling the cylinders and pistons in the practical engines prevented the accomplishment of the isothermal and adiabatic processes and the attainment of the Carnot or perfect heat cycle, but the approach to it has made the Diesel the most nearly perfect in thermal efficiency of any practical heat engine.

To illustrate the power balance of the stroke, data for the cycle of a 2-cycle engine of large size have given from the indicator card: 500 pounds per square inch initial pressure, 150 pounds per square inch mean forward pressure during the working stroke, 50 pounds per square inch during compression stroke, giving a mean effective working pressure of 100 pounds per square inch.

From 1893 until 1903 nothing of note was undertaken with the Diesel for marine use. At the latter date a small barge of 265 tons capacity was engined with a single motor of 25 B. H. P. From 1903 to 1908 the progress was slow and, in fact, nothing was done at all in marine work in 1906. This slow progress was due no doubt to the non-reversibility of existing types and to clutch difficulties. Beginning with 1908 there were eight vessels completed; five in 1909; sixteen in 1910; thirteen in 1911; and twenty-three vessels completed or to be completed in 1912. The vessels now in operation include vessels from oil-barges of 300 tons, to mail and passenger steamers of 10,000 tons; and speeds of 5 knots to speeds of 14 knots. The foregoing does not include vessels under 100 feet in length, of which there are about 250; nor does it include any naval vessels, though it is well known that the Russian government has had several gunboats engined with Diesel

engines, in service for a number of years; the French and Italian governments have a large number of submarines engined with Diesels: and our own navy has two vessels, E-1 and E-2, in service so engined, and several more under construction. This type of power is being considered for the submarine tender appropriated for by the last Congress.

The English Admiralty has taken up the construction of a twin screw vessel with a turbine and a heavy oil engine on each shaft; the heavy oil engine forward of the turbine and connected to the shaft by a clutch. For high speeds the turbine is to be used, and at low or cruising speeds the oil engine is to be used. This seems to be rather forcing things, as aside from the expensive installation, the value of the results are menaced by the problem of propeller design. In an old cruiser they are removing one engine and replacing it with a Diesel of equal power. In this case a few of the boilers are to be removed, and exhaust is to take place below the water line. This experiment should give valuable data for comparison. In the English navy the first Diesels were installed, for dynamo drive, in the *Dreadnaught,* and since that time every battleship or armored cruiser put in commission by the Admiralty has been equipped with these engines.

The German installation of the 12,000 B. H. P., 6-cylinder, 2-cycle, double-acting engine is now well advertised. It has developed, however, that the vessel for which this engine was intended is now to be completed with turbines, and further that she was designed with full boiler power for a complete turbine equipment. These points may be rather significant as representing a conservative German view. In a test of three cylinders of the 12,000 H. P. engine recently, oil gas from some source was admitted to the cylinder with the scavenging air, forming an explosive mixture, which was ignited and caused an explosion which wrecked part of the engine, killed several men, and caused a serious fire which threatened the entire destruction of the engine. In the absence of other information is is probable that the cause of the trouble was the use of lubricating oil, in the air compressor, from which the lighter distillates had not been removed.

Types, etc.—The steam plant is composed of two main divisions in which the working process is carried out. The boilers furnish the working medium in a state for use in the cylinders of the prime mover. In the Diesel the whole process is dealt with in the

cylinders. For the delivery of the heat energy of the fuel to the working shaft there are the following types and possibilities: (1) 4-cycle single-acting: (2) 4-cycle double-acting: (3) 2-cycle single-acting: (4) 2-cycle double-acting.

A brief discussion of the relative advantages and disadvantages of the basic 2-cycle and 4-cycle types will perhaps shed some light as to which should be preferred for naval purposes. An essential feature of all types is that they require an auxiliary air compressor capable of compressing air to a sufficient pressure to inject the fuel oil into the working cylinder of the engine, a pressure of about 850 pounds to the square inch.

Between the 2-cycle and 4-cycle types the 2-cycle should give at a given speed and the same piston displacement about, though not quite, twice as much power as the 4-cycle. Hence the 2-cycle will give a more compact and a lighter machine than the 4-cycle, for a given power and speed. A special system of scavenging is necessary for the 2-cycle, in order to clear the cylinder of the products of combustion at exhaust, but this clearing-out of the burned gases is more thoroughly done than it is in the 4-cycle, which depends on the idle stroke of the piston for scavenging. This favors the use of a less refined, hence cheaper, oil in the 2-cycle. It is of the utmost importance that the products of combustion be thoroughly driven out of the cylinder, as upon this depends largely the efficiency, reliability, and capacity of the engine.

As for every revolution of a 2-cycle engine there is a power stroke as opposed to two revolutions to a power stroke in the 4-cycle, the 2-cycle is much more readily maneuvered and reversed. Owing to the nature of the cycle the pairs of cranks in a 4-cylinder 4-cycle engine are always placed 180 degrees apart, therefore to provide reversibility in any position at least six cylinders are necessary in the 4-cycle. For a 4-cycle even of six cylinders a fly-wheel is required; this is not necessary in the 2-cycle. Better shaft torque is given by the 2-cycle. For equal power the initial cost of the 2-cycle is from 10 to 25% less than the cost of the 4-cycle, but the fuel consumption of the 2-cycle for equal power is about 10% greater than the 4-cycle. In the 4-cycle the cylinder cover contains an air admission valve, fuel admission valve, exhaust valve, and a compressed-air valve for starting and reversing the engine. In the 2-cycle the cylinder cover contains only a fuel admission valve and a compressed-air admission valve.

The scavenging-air valve may be placed in the cover also, but it seems that for the sake of simplicity and ease in removing the cylinder cover a better place is in the cylinder wall, approximately opposite the exhaust ports which are uncovered by the piston during the latter part of its stroke.

All valves are kept closed by powerful springs and are actuated by cams on a cam shaft, running the length of the engine and driven from the main shaft by skew gearing and a vertical shaft.

In both types the compressed-air admission valves are used only for starting and reversing, and the actuating cams are so arranged that the fuel admission and the compressed-air admission valves cannot be in operation at the same time. By shifting the cam shaft in the direction of its length the proper amount the cams are thrown in for starting, reversing, or whatever operation is desired.

The 2-cycle requires special scavenging arrangements which are usually, though not necessarily so, driven off the main shaft, causing loss of mechanical efficiency; this loss, however, is probably not more than that which is lost in the 4-cycle in driving pistons two idle strokes out of four.

In summing up it seems that the balance is vastly in favor of the 2-cycle, with the single exception of a slightly larger fuel consumption; it is believed that this will be outweighed in the long run by other advantages, however. Relative to the double-acting or single-acting engine the way leads without question to the double-acting as the ultimate type, following the lines of the double-acting steam engine. The difficulties anticipated with the stuffing box have been satisfactorily surmounted; there remains, however, the problem of spraying oil into the bottom of the cylinder for complete combustion without the fitting of at least three fuel admission valves, and thus complicating the gear and cams. This is due to the piston rod occupying the center line of the cylinder.

In the determination of the number of cylinders relative to the best torsion moment of the shaft it has been found that the turning moment of the 12-cylinder, 4-cycle; 6-cylinder, 2-cycle; and the 3-cylinder, 2-cycle, double-acting, give the same uniform turning moment and a superior turning moment to that attained by the usual triple-expansion 4-cylinder steam engine; hence the 3-cylinder, 2-cycle, double-acting will be taken as the unit for propulsion purposes.

For electric-generator drive and necessary auxiliaries for air-compressing, etc., the choice should lie with the single-acting type for the sake of simplicity; as regards the 2-cycle and 4-cycle types the choice should be governed by the conditions that exist at the local point of installation. The 2-cycle presents a more compact and a lighter machine for the same power; the 4-cycle presents perhaps a simpler installation with a slightly better fuel consumption.

Fuel.—The Diesel engine has the advantage of being able to consume oil that cannot be used in engines of lower compression without the aid of special ignition devices, and it can also use oils that are of no value for any other purpose. Some one has very aptly stated that "it can burn any old stuff in the nature of petroleum"; but it can go even farther than this, as fat oils from vegetable or animal sources have been used advantageously without any change in the engine whatsoever. Petroleum can be used in its raw state, as crude oil, in the condition in which it leaves the earth; but for universal use the residual oil after the lighter hydrocarbons have been distilled off is better, as there is little liability of danger from the oil gases. Such oils have a flash point of about 130°C. and can be purchased in this country for about two cents per gallon, or about $4.50 per ton.

Oil of an asphalt base is not entirely suitable for the Diesel engine on account of the liability of a deposit of an unburned residue in the working cylinders and mechanical difficulties of properly supplying the oil through the fuel pipes and valves that will become gummed by the asphalt oil in the presence of heat. Oil of a marked sulphur constituent is also undesirable, particularly in engines having copper or bronze fuel supply pipes and fittings due to the affinity of sulphur for the material of such fittings. However, the problem of the effect of asphalt, sulphur, and water in fuel oil is still more or less of an open question and it is a problem that merits thorough investigation.

In this connection it is noted that there is a deplorable lack of standardization relative to terms used in speaking of fuel oil. Crude oil is the raw oil as it comes from the earth, after the earthy impurities have been strained off, but this term is frequently used to indicate oil that has been freed from its lighter distillates. In Russia real crude oil is known as naphtha. In England petroleum is known as paraffine, and on the continent of Europe the oil

produced by the distillation of brown coal is known as paraffine. This promiscuity of terms is confusing at best.

Fuel Consumption.—In the smaller sizes of Diesel engines manufacturers guarantee a full load consumption of .50 of a pound per brake horse power; at ¾ load .52 of a pound; at ½ load .60 of a pound; and at ¼ load .80 of a pound. These are conservative claims and in larger sizes the economy is greater, but the increase in size does not bring increased economy in the same ratio that it does in the steam engine; but this is of small moment in comparison, considering the marvelous economy attained by the Diesel. To show the margin of safety in the manufacturers' guaranteed claims, every-day figures for an installation of moderate size give .44 of a pound per brake horse power at full load; .45 of a pound at ¾ load; .47 of a pound at ½ load; and .62 of a pound at ¼ load. These figures are not a record, but are figures for every-day performance under actual running conditions. A recent battleship on her trials gave 12.6 pounds of water per I. H. P. at full power, which at a mechanical efficiency of 85% gives about 14.8 pounds per B. H. P. The actual evaporation was 11 pounds of water per pound of coal, exceptionally good, which gives 1.3 pounds of coal per B. H. P. at full power. This is exceptionally low consumption, but when compared with .50 of a pound in the Diesel there is a ratio of approximately 1 to 3. This consumption at full power in the Diesel is not exceptional. At the battleship's economical speed the ratio becomes 1 to 5 in favor of the Diesel at that speed. Equal storage capacity will take about one-fifth more oil than coal, and for the vessel in question the radius will accordingly be increased about six times by the installation of Diesel motors of equal power, at the economical speed of the steam engine.

As to the weight of the Diesel engine, a slow-speed, heavy machine of 150 R. P. M. full power including all necessary auxiliaries will weigh about 100 pounds per B. H. P. This gives a sturdy machine with no delicate construction whatsoever, or introducing the complication of incessant watchfulness of bearings while in operation. The present steam installation of a battleship will run about 210 pounds per B. H. P. The vessel taken for this comparison is the *South Carolina* with an I. H. P. of 18,250, or at a mechanical efficiency of 85% about 15,600 for effective horse power. Her propelling plant may be replaced by two double-acting 2-cycle engines of a total horse power

of 20,000, or three double-acting 2-cycle engines of 18,000. This refers to brake horse power in each case. The only reason for installing three engines and three shafts instead of two would be for the better control of the ship at dead slow speeds. At the present state of the development of the Diesel engine, on account of the necessity of the high heat of compression for the proper ignition and combustion of the fuel, the usual slow speed guaranteed is one-third speed, although by cutting out certain cylinders one-fourth speed has frequently been easily maintained; this would be about 38 R. P. M., or say five knots per hour, with a two-engine installation and the *South Carolina's* present propellers. Assuming the first installation of two engines, 20,000 brake horse power, 4400 more than the present steam installation. a saving in weight of 611 tons of machinery is at once realized. For an installation similar to that of the Italian and French submarines actually installed and operating, the engines weigh about the same as steam engines of like power, including all engine auxiliaries of each installation. The weight of all boilers and necessary accessories is thus saved. A note in one of the technical journals a short time ago gave a French estimate on one of the old French battleships in which a saving of weight of 400 tons and three-fifths of the machinery space would be realized by an equipment of Diesel engines.

Relative to space, the engines will occupy a floor space of approximately 50 feet by 18 feet, and will stand about 26 feet high. This floor space will not include the air compressors for fuel supply, reversing, and starting, but will include the necessary scavenging cylinders driven off the main engines by connecting levers to the crossheads, similar to the manner in which air pumps were formerly driven. The air compressors will be driven by separate Diesel engines of about 300 horse power each, and may be placed where most convenient in the engine room. The engine rooms will be a little larger than at present, but almost all of the boiler space and bunkers will be entirely free from use with the propulsive plant.

The speed of revolution will be about the same as at present; hence the propeller efficiency will remain unchanged.

As to reliability, Diesel engines are running long non-stop runs and tests of much longer duration than they will be required to perform in actual service. A recent concrete example at hand is

a 30-day non-stop test of a 2000 horse power 4-cycle engine in Scotland, the engine being found in as perfect condition at the finish of the test as it was at the beginning. Numerous similar examples may be found. At the Birkdale, England, electric works there is a Diesel engine that has been in operation for the last four years on an average of 23¾ hours out of every 24 during that entire period, being stopped 1½ hours each Sunday. This engine is a Mirrless-Diesel built by the firm that has supplied these engines to the British Admiralty for generator drive and other purposes. A further exhibit noted in the discussion of J. T. Milton's excellent paper on Diesel engines for ship use, is of two Diesels, 80 horse power each, of seven years continuous service; out of which time they were in actual operation 36,000 hours without a thorough overhaul. They were finally completely dismantled and found to be in excellent condition and were put together again with very little work. During the three years immediately previous to dismantling, the repairs to the two engines, which consisted mainly of replacing valves, aggregated about $60.00 per year. The fuel consumption at the time of overhaul was .43 of a pound per brake horse power at 80% load. The above seem to be fair examples of upkeep and reliability.

Relative to the handling of the engines, tests of certain installations have shown the time from full speed ahead to full speed astern as 3 seconds, and full speed ahead to stop or the reverse 2½ seconds. This was for a small plant, but for the *Selandia's* engines of 1250 horse power the time from full speed ahead to full speed astern or the reverse is 20 seconds. This is for a 4-cycle single-acting type, and is longer than the time for the same maneuver in a 2-cycle single- or double-acting type. An Italian test of a unit for a 6-cylinder, 2-cycle, double-acting engine designed for 12,000 horse power gave reversal tests of 6 seconds. A table from the *Engineer* relative to practical results derived from a comparative test of two marine installations of the same power, one of steam and the other Diesel motors, gave the following:

	Steam.	Diesel.
1. Engine from stop to ahead or astern.....	4/5 sec.	2/5 sec.
2. Engine from full ahead to full astern.....	15 sec.	8 sec.

Maneuvering tests have been conducted and from 40 to 50 maneuvers carried out per hour with the greatest ease and reliability. No difficulty should be experienced in speed regulation, as there

are thousands of stationary Diesel engines running daily where the revolutions are governed to within one or two per cent by automatic governors; this is as good as is done with steam. For a marine plant it seems that the governing should be done entirely by hand and that the speed regulation should, if anything, be accomplished more readily and reliably than in the steam engine. The oil is always ready for use and the amount going into the cylinder and the pressure of the injection air can be regulated with the greatest accuracy. In the steam engine the operator is dependent upon the boiler pressure, which at best is not constant. Further in this connection, there have been many harassing experiences in the fleet for the engineers of the watch when getting under way to join formation, and a call comes suddenly for a comparatively high rate of speed from a dead stop. It is usually a case of fight to build up the power and it is a long hard pull before it comes. In the Diesel the power is always right at hand and only needs to be used by the setting of a small hand wheel or lever. From full speed ahead to a sudden stop there is no hurry and scurry to control a high steam pressure. The proper power developement is not dependent upon the skill of many men throughout the department, but solely upon the proper adjustment of the fuel supply by a single operator at each engine.

Continuing further with the comparison of the *South Carolina* numerous other features will follow with the introduction of Diesel power on her with the entire elimination of steam. Electric power will be used for all auxiliary purposes, such as winches, ammunition hoists, sanitary and bilge pumps, steering gear, galley, etc. Water-circulating and forced-lubrication pumps for the main engines are also electric-driven, as in the case of securing the main engines it is advisable to continue the circulation to allow all parts to cool gradually; also, if oil is used for cooling the main pistons, the high heat stored in these pistons will be transmitted to the oil in the circulating passages and cause deposits by decomposing the oil, unless it is kept in circulation after the engine has stopped. A standby air compressor electrically driven should be placed in each engine room in case of loss of air for the main engine and auxiliaries. The application of electric power throughout the ship can be accomplished on the present dynamo plant of four 200 K. W. machines. The present turbines as the prime movers of the generating sets will be replaced by 2-cycle, single-acting engines

of about 280 horse power, weighing about 90 pounds per K. W. and running at 300 R. P. M. This is a substantial, comparatively heavy slow-speed machine, and at full power should consume about .45 of a pound of fuel per horse power, or say at a usual 50% power factor .50 of a pound per horse power. This fuel economy over the present dynamo plants on ship board will remove one of the most potent factors in the argument favoring the installation of alternating currents on our ships. The placing of these complete separate generating units in the dynamo room, removal of all steam lines, condensers, etc., tends to reliability, simplicity, and elasticity in the location of power units, also a high percentage of saving of weights. In the engine and boiler rooms the following will be eliminated: condensers, feed tanks, and all accessories, feed pumps, feed heaters, boilers, auxiliary feed pumps, forced-draft blowers, super-heaters, ash expellers and accessories, coal bunkers, coal, ashes, ash-hoisting apparatus, all firing tools, etc.; stores and store rooms will be simplified, and the water-tight door system simplified. Other changes throughout the ship are numerous, some of them being the abolition of smoke pipes, fire room ventilators, fire room hatches, all coal-handling gear, trucks, booms, etc., all coal chutes, and enormous hatches. There will be no steam pipes or steam leads of any sort except such as may be required for heating living compartments, or for the evaporator installation. The evaporator plant will be much smaller, as with the abolition of the boilers there should not be a demand for a make-up of over 10,000 gallons per day at the maximum. This does not take into consideration the lessened demand of the personnel due to the reduction of the fire room force, who by the nature of their employment require large quantities of water daily. For the evaporators the heat of the exhaust of the dynamo engines may be utilized, but this is a little problematical. The two problems that seem to present difficulties are the heating of the living compartments and the operation of the whistle. It is possible that a heating plant similar to that of any large apartment house could be used, or the heat of exhaust gases; perhaps electric heating will be the simplest solution. For the whistle it has been found that compressed air gives a sound superior to steam, but it does not give the visibility that is so valuable in steam, though not called for by the rules of the road; also in cool weather there is danger from freezing due to the expansion of the air through the whistle.

The engineer force will be much reduced, repairs and upkeep will be simplified and standardized. The vessel's radius will be increased at full power about four times, and at economical speed about six times, the engines will always be ready for instant service with no stand-by losses whatsoever. Tests made with a cold Diesel engine were carried out in which in 6 seconds from the time of the first operation to start the engine it was at full power and taking its full rated load. The ship will be able to take her full power speed at the instant of getting under way, and maintain it to the limit of her fuel endurance, which is a thing that no battleship in existence can do, unless her fuel allowance is entirely in oil and she can carry enough fresh water to take care of the make-up feed. A statement of a more or less *ex-cathedra* nature has been made to the effect that no steam-driven ship can be driven to the limit of her fuel endurance at full power owing to the enormous water losses. But even so, laying aside the question of water endurance, it is probably beyond the limits of physical endurance for the personnel of the engineer department of a steam-driven man-of-war to run her to the limit of her fuel capacity.

We have then in the final estimate the following favorable points of the Diesel engine: (1) The construction of the engine is simple and strong; each cylinder is an independent unit, developing its proportional share of the engine's power; the operation of the machine is simple and reliable. (2) Economy of fuel gives an increase of from four to six times in the radius, and the actual cost is two or three times cheaper. (3) Does away with smoke pipes, boilers, steam pipes and leads, and all of the many and various accessories of a steam plant, their repairs and the personnel for their up-keep and operation. (4) The engines are always ready for operation immediately, and all stand-by losses are eliminated. (5) All parts of the power equipment can be made standard; hence repairs are simplified and time spent in repairs greatly shortened. There should not be any more trouble with the main engines of a battleship than exists at present, and it does not require much imagination to estimate the ease of up-keep if everything in the way of machinery in the propulsive department of a battleship should be wiped out except the main engines. (6) Engine room temperatures are much reduced, being little above the temperature of the outside air; in fact, it is anticipated that the engine room will be supplied with heat for the comfort of the personnel. (7) The

abolition of boilers and smoke pipes will greatly simplify the location of turrets and the stowage of ammunition. (8) The abolition of coaling hatches, fire room hatches, ventilators, and coal bunkers will simplify construction. (9) Absence of smoke; the exhaust should be practically colorless and odorless, as the combustion in the working cylinders is perfectly complete with proper fuels. (10) The oil fuel itself brings many advantages; viz., (a) rapid and cheap loading of fuel, (b) entire absence of dirt and dust, (c) elimination of ashes and cinders, and gear for handling them, (b) capability of storage in compartments ordinarily of little value as storage space, (e) no waste of space in storage compartments, (f) absolute safety of residual oils on ship board, no danger from spontaneous combustion or conflagration. Tests conducted with explosive shells against tanks containing fuel oil have produced no combustion. Should a double-bottom fuel-oil compartment be pierced by an explosive shell or torpedo, the absence of the necessary heat combined with a sufficient amount of oxygen would prevent combustion. (g) Oiling at sea is a comparatively simple operation and can be conducted under unfavorable weather conditions. Coaling at sea is almost an exact science. Togo would have waited in vain in the Sea of Japan, had he been opposed by a fleet of Diesel-engined vessels with their enormous radius of action and easy means of refilling their oil tanks. (h) One pound of oil in the working cylinder of a Diesel engine will do four times the work of an equal amount of coal in the furnace of a steam boiler. It seems a brutal waste of energy to burn bituminous coal if it can be made to yield, by distillation, suitable oil for heavy oil engines.

Some of the disadvantages noted have been: (1) The need of frequent cleaning of cylinders; this has not been borne out in practice and the attention given the marine steam engine in the naval service should be sufficient. (2) Cost of oil will go up as the demand increases and that the world's supply is limited; this is answered by the fact that the present price of residual oil is governed by the price of its distillates, gasoline, kerosene, etc., and by the fact that the price of coal has not increased in proportion to the increased demand in normal times. Hence such an argument against oil does not appear to be sound. Further, the ease with which oil is produced as compared with coal makes the likelihood of the supply of oil being entirely stopped by industrial troubles such

as have gripped England and other European countries and threaten this country at times, seem to be quite remote. The inability of the Navy Department to secure coal cargoes for the period of time that the recent coal troubles menaced England would seriously hamper the operations of our fleet, especially on the Pacific coast. As to the supply of oil, new fields are being discovered and the present supply of oil is believed to be as extensive as the supply of coal. Diesel engines consume oil one-quarter as fast as coal-burning vessels consume coal; therefore we seem to be safe on that score, even if there were three times as many motor ships as coal-burning ships. The applicability of animal and vegetable oils to the Diesel furnishes another field from which fuel way be drawn that is not open to the steam plant. The United States is especially favored in the oil supply, as at the present time this country produces 90% of the paraffine base oils, which is the oil par excellence for use in Diesel engines. (3) Danger from explosion and spontaneous combustion; the residual oil from which the lighter hydrocarbons have been distilled is absolutely safe, safer than coal.

One disadvantage that is seldom, if ever, mentioned is the cost of the Diesel installation. The first cost is extremely high, costing more than a steam plant of equal power including boilers, engines, and all accessories. This is no doubt higher than will be the future cost, but the workmanship and materials must be of the best to stand the continuous high pressures and temperatures. Other objections have been: (a) danger from racing in a heavy sea, but that hardly seems valid; (b) the helplessness of the plant due to loss of air; that objection also seems a little forced, especially in an installation where the personnel is of a high order. The loss of air is not any more likely than the loss of vacuum on a steam vessel, and a more helpless machine than a high-power steam vessel with no vacuum on her condensers would be hard to find.

The progress of the Diesel engine will no doubt be greatly accelerated by the recent expiration of the original Diesel patents. The strides taken in the past two or three years have been enormous, and it is most instructive and enlightening of the futility of human prediction to read articles written by engineers of note and published in the columns of leading technical journals about five years ago, in which it was asserted, with the figures to prove, that the power and size of the Diesel engine could not go above certain

proportions; the proportions were surpassed before the figures had become cold. The impossible was accomplished while it was still impossible.

The steam turbine is a step between the steam and the oil reciprocating engines, and perhaps in time the reciprocating oil engine will make way for the oil or gas turbine. The progress so far has been so logical, proceeding from complexity to simplicity, that further simplicity does not seem unreasonable; it may be that the province of the perfect heat cycle itself will be threatened.

THE FUNDAMENTALS OF NAVAL TACTICS.

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CHAPTER V.

TORPEDO-BOAT MANEUVERS.

66. *Characteristic Conditions of the Attack of Torpedo-Boats.*—In the study of the maneuvers of ships opposing each other we have logically held that at all times each of the adversaries seeks to maneuver opportunely; but the essential characteristics of the nocturnal attack of torpedo-boats are surprise and high speed; hence we do not reason in an entirely aprioristic way when supposing that while the torpedo boats execute the maneuver of approach, the ship attacked continues on her course. It would, however, be erroneous to deduce from this that the maneuvering reduces itself to solving a simple problem in kinematics; indeed it is necessary to keep in mind the conditions of extreme uncertainty that are realized in practice. With the assistance of Daveluy (*op. cit.*) let us fix our thoughts upon the difficulties that a torpedo-boat encounters in attacking a ship in motion.

The enemy is sighted in the form of a black mass. The torpedo-boat must take account of the direction in which its objective is moving, and then gain an advantageous position for the maneuver of approach; that is to say, a position from which, steering to arrive at launching distance, there may be assured to the torpedo a convenient angle of impact.

This is very easy to define but very difficult to realize. When, on sighting the ships, one is not in the aforesaid advantageous position, in order to gain it one risks losing the benefit of the surprise; and for the rest, it is not easy to know whether one is or is not in an advantageous position; one is led by this to steer to approach the enemy's mass, which is hardly distinguishable, reserving it to himself to maneuver afterwards as he may.

In general, then, we cannot succeed in solving the problem of approach in a theoretically exact manner; moreover, when we have taken account of the direction in which the enemy is moving, we still shall not have succeeded in estimating his speed, nor may

we rely upon making this estimate in time; which would be necessary in order to construct the triangle for launching the torpedo.

From such conditions of uncertainty results *the necessity of launching from a very short distance.* The improvements made in the torpedo are to be considered as important, not because they give the means of launching, for example, at 1000 meters instead of 500, but because they confer upon the torpedo launched at the latter distance a higher speed than it had before, and hence a greater probability of hitting.

The results obtained by the Japanese torpedo-boats after the battle of Tsushima did not depend alone upon the fact that the artillery battle had deprived the surviving Russian ships of a part of their means of defense, but were due to the close and vigorous manner in which the attacks were conducted. Togo, in his report of the battle, expresses himself in this connection in the following words: "According to information gathered from the prisoners, the attacks of the torpedo-boats during the night were extraordinarily impetuous. They hurled themselves at such speed and approached so rapidly that it was impossible to stop them; they came so close that the guns of the ship could not be sufficiently depressed in order to hit them."

While it is necessary to remember that the real conditions of the torpedo-boat attack will be those just mentioned, this does not exclude the advisability of reflecting upon the theoretical conditions of the maneuvering, considering them as the limit toward which we must tend. The general criterion of launching from a short distance being established, in the following reflections we shall hold that the run c to be considered as normal for the torpedo in a night attack of torpedo-boats is that of 500 meters.

67. *Maneuver of Approach.*—It is well known that the rules which practically apply for the maneuver of approach can be formulated as follows: 1st. If the torpedo-boat finds itself to one side of the ship, it must steer as if it desired to meet that ship (section 32, I) (lateral attack). 2d If the torpedo-boat finds itself almost exactly ahead of the ship, in approaching it should move somewhat to one side, and afterwards steer a course opposite that of the ship (attack in passing on opposite courses). When the torpedo-boat sights the ship in a stern sector, since the lateral attack would be too long, it must first, without approaching so as

to be seen by the enemy, gain a convenient bearing and then maneuver as in the first case.

We do not desire to create complications by seeking for different rules, but we propose to fix our minds on the rules alluded to; observing that, from what we have set forth in section 32, their theoretical exactness might be placed in doubt; and we now wish to demonstrate that these rules are very nearly exact.

1st. If V_N is the speed of the ship N that it is desired to attack, and v is the speed of the torpedo, as we have already had occasion to note in section 9, the geometrical locus of the positions from which the launching may be executed in such a way that the torpedo may strike the ship after a run c is obtained by making NN_1 (Fig. 42) equal to $c\frac{V_N}{v}$, describing a circle with a center at N_1 and with a radius c, and then limiting to right and left of the ships the arcs—as SS'—included between the straight lines, passing through N_1, that form angles of 30° with the course.

The theoretically exact maneuver for the approach would then be the one for arriving on the arc SS' in the shortest possible time. Setting aside the angle of impact, the problem of kinematics is that of bringing oneself in the minimum time to a distance c from the imaginary point N_1; and hence, if the maneuver could be executed with theoretical precision, from what we said in section 32, II, on arriving at launching distance in the shortest time, the torpedo-boat should find N_1 in the direction of its bow. In other words, the maneuver of approach should be executed in such fashion that, if the torpedo-boat had a bow launching tube, on arriving at launching distance it should have no need of changing direction in order to execute the said launching. We note this circumstance in order to fix the idea, and not because we at-

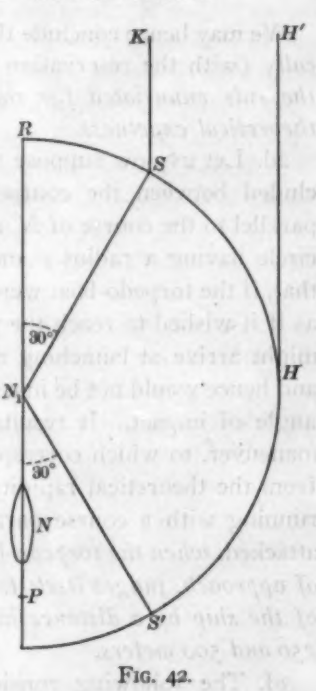

FIG. 42.

tribute to it any special importance; the bow tube being generally abolished.

So, then, in order to arrive in the minimum time at the distance c from the imaginary point N_1, it would be necessary to maneuver (see section 32) as if it were desired to reach a point P, which is moving at a speed V_N, and situated astern of N_1 at a distance

$$N_1P = c\frac{V_N}{V_T},$$

V_T being the speed of the torpedo-boat.

On the basis of the value of NN_1, above mentioned, the point P is distant from N a length $NP = N_1P - N_1N = c\left(\frac{V_N}{V_T} - \frac{V_N}{v}\right)$.

Evidently the distance NP is very small; so, putting $\frac{V_N}{V_T} = 0.8$ and $\frac{V_N}{v} = 0.5$, we have

$$NP = 0.3c = 150 \text{ meters.}$$

We may hence conclude that, *besides being easily applied practically* (with the reservation mentioned in the preceding section), *the rule enunciated for the lateral attack is also very near to theoretical exactness.*

2d. Let us now suppose the torpedo-boat to be in the zone included between the courses HH' and SK, both of which are parallel to the course of N, and the first of which is tangent to the circle having a radius c and its center at N_1. It is readily seen that, if the torpedo-boat were to execute the maneuver of approach as if it wished to reach the point P or the center N of the ship, it might arrive at launching distance at some point of the arc SR, and hence would not be in a position for launching with a sufficient angle of impact. It results from this that the sure and simple maneuver, to which corresponds a rapidity of approach differing from the theoretical rapidity by a negligible quantity, consists in running with a course parallel and opposite to that of the ship attacked, *when the torpedo-boat, at the beginning of the maneuver of approach, judges itself to be laterally removed from the course of the ship by a distance included between c and $\frac{1}{2}c$, or between 250 and 500 meters.*

3d. The following considerations are sufficient to show the necessity for the torpedo-boat to avail itself of its greater speed

in order to gain a position in a forward sector of the enemy's ship when the latter is not sighted from such a position.

The danger zone for a torpedo-boat is naturally that in which there is great probability of being hit by the guns without being able to launch a torpedo. Since we are referring to a night attack, the range of the anti-torpedo-boat guns—that is to say, the radius of the danger zone—may be held to be about 2000 meters; and it is to be noted that the distance at which the torpedo-boat sights the ship is often not greater than this. The inferior limit of the danger zone is constituted by the circle with its center at N_1 and the radius c (Fig. 42), which circle moves with the ship at a speed V_N.

So, then, it is clear that the further forward is the bearing on which the torpedo-boat begins the approach, the more rapidly will it traverse the danger zone, for two reasons: I. The relative speed being so much the greater, so much the more rapid will be the variation of the distance. II. So much the greater will be the distance at which the launching can be executed. It may be noted that in giving importance to this we are not in opposition to the criterion established—that of launching from a short distance. It is very true that we may not pretend to diminish the danger zone by launching the torpedo for a long run, because in so doing we should obey a mistaken defensive sentiment, and we should risk rendering our offense inefficacious. The torpedo-boat that thinks of protecting itself instead of attacking vigorously is a torpedo-boat lost without having accomplished anything. But in the case under discussion the situation is different; the term *short distance* must be precisely understood in the sense of *a short run for the torpedo;* and the further forward (up to the line SK) is the position of the torpedo-boat, so much the more may we launch from a distance, the run of the torpedo remaining as short as has been established, without having a notable difference in the probability of hitting.

68. *The Maneuvering of a Flotilla of Torpedo-Boats.*—Owing to the characteristic difficulties of the torpedo-boat attack pointed out in section 66, it is necessary that the attack be executed by a certain number of units; there being thus the possibility of producing uncertainty in the firing of the enemy, who is obliged to distribute his offense among the different targets; and permitting the hope that the number may remedy the scant probability of

individual success. Nevertheless, as Commander Vannutelli has observed (*Rivista Marittima* for May, 1910), it is well to consider the following axioms:

1st. The probabilities that the torpedo-boats will be hit before arriving at launching distance increase with the compactness of the order of attack; since, when the torpedo-boats are very close together, they constitute a single, extended target, easily visible; and, *vice versa*, they diminish with the increase in the dispersion of the torpedo-boats in the direction normal to the line of fire.

2d. The same probabilities increase with the increase in depth of the order of attack of the torpedo-boats in the direction of the bearing of the ship; that is, they are maximum when the various units keep on or near the same bearing from the ship, thus exposing themselves to raking fire. It results, therefore, that it is necessary for the torpedo-boats to have a suitable dispersion, and to arrive at the launching position simultaneously rather than successively.

But the length of the chord SH (Fig. 42) is equal to 500 meters, the angle SN_1H being 60°; we deduce therefrom that the maximum number of torpedo-boats that may *simultaneously* attack a ship from one and the same side, to the end that they may be properly separated, must be held to be *three*.

Having to aim at simultaneity of attack, the torpedo-boats of this group, in distancing themselves from each other for the execution of the maneuver of approach to the ship, must arrange themselves on an alignment normal to the line joining their center with N_1; thus also satisfying approximately the second of the axioms just enunciated. It can be established as a practical rule that the alignment may possibly be normal to the line joining its center with a point a little ahead of the ship to be attacked (the further ahead, the higher is the speed V_N).

From this alignment, the torpedo-boat occupying the central position may begin its maneuver of approach as if it were alone; and the others must follow a course parallel to it.

The action of one of these groups, which attacks the ship on one side, evidently favors the attack of a similar group on the opposite side, if this is made after a very short interval of time; since, from the moment in which it is discovered, it may be predicted that it will absorb practically all the attention of the enemy.

There is thus developed the advisability of constituting squad-

rons of torpedo-boats of six units, divided into two sections, destined to maneuver for the attack separately but co-ordinately.

Evidently, the attack of the sections on the two sides can be made on condition that the squadron, on sighting the ship, finds itself on the line of the course of the latter; otherwise the sections will attack successively; it may be presumed that the first attack, if it does not succeed, will be an efficacious preparation for the second; because, in the minutes following, there will be a relaxation of vigilance.

Such seem to be the guiding criteria, not excluding that it may be advisable to depart from them under special circumstances, in order to adapt oneself to the movements of the enemy, if he moves as the searchlights are directed, toward the number and position of the torpedo-boats illuminated.

The employment of several squadrons against a fleet of ships requires as a preliminary condition the envelopment of the enemy; that is to say, taking the position with the squadrons in different points of the horizon so that the adversary cannot withdraw from the attack. But it is needless to say that the problem of envelopment ought not to be considered a problem of kinematics; criteria for its solution cannot be pre-established, because the envelopment is to be held possible only when the adversary's fleet is occupied in an artillery battle. Typical conditions for a general attack are those described as follows in the already cited report of Togo: "Night was beginning to fall. Our torpedo-boat squadrons had already enveloped the enemy to the North, East and South. Consequently the principal squadron ceased fighting and withdrew at sunset."

69. *Tactical Action by Day.*—Let us recall to mind the beginning of the battle of August 10, 1904. The Russian squadron saw numerous torpedo-boats ahead, and, fearing that they might have thrown out blockading mines, changed course 90°. An action of such nature, which obliges the enemy to make a movement not required by the situation with respect to our battle forces, may be of great assistance to us.

A movement of destroyers directed so as to arrive at launching position may evidently be admitted against damaged ships, as was done at Tsushima against the *Souwaroff;* it may not be excluded with uninjured ships, on condition that the two principal fleets are not very far apart. Indeed, by day, the danger zone for torpedo-boats is so extended, and the fire of the medium artillery is so

precise, that the launching would have to be executed from a very long distance; and since, under such conditions, there is very scant probability of success, it is not worth while to expose the torpedo-vessels. When, however, the distance from the enemy is relatively short, that is, when, for example, the two fleets are fighting at close range, if nothing else is accomplished, the torpedo-boats will oblige a part of the enemy's ships to make a movement not required for its tactical employment with respect to the battle fleet; which may produce important consequences.

70. *The Maneuvering of a Submersible.*—A submersible, for an attack by day, finds itself in conditions analogous to those of a torpedo-boat in a night attack, with the added disadvantage of its inferiority in speed with respect to the ship. It must submerge at a distance of about three miles from the ship and steer for the approach; rectify the course by emerging the periscope, and then execute the launching. We propose to determine the sector in which the submersible should be found with respect to the ship at the moment of approach, in order that conditions making it impossible to arrive at launching position may not exist.

Let us suppose that the submersible executes the maneuver of approach according to the first rules indicated for a torpedo-boat; that is to say, it steers as if it wished to meet the ship.

Let a be the polar bearing we are seeking, or, the maximum angle that the ship-submersible joining line may make with the course of the ship in order to permit of approaching. Let us indicate by V_N and V_s the respective speeds of the ship and of the submersible, and, naturally, let V_N be greater than V_s.

From section 32, I, there results

$$\sin a = \frac{V_s}{V_N};$$

and hence for $\frac{V_s}{V_N} = \frac{8}{12}$, we have $a = 42°$; for $\frac{V}{V_N} = \frac{8}{16} = \frac{1}{2}$ we have $a = 30°$.

With the course of reasoning of section 67, in Fig. 42, we obtain

$$NP = c\left(\frac{V_N}{V_s} - \frac{V_N}{v}\right).$$

Making $\frac{V_N}{v} = 0.5$, we have:

$$\text{for } \frac{V_s}{V_N} = \frac{8}{12}, \quad NP = c;$$

$$\text{for } \frac{V_s}{V_N} = \frac{1}{2}, \quad NP = 1.5c.$$

The value of the distance NP is not, then, as small as in the case of a torpedo-boat; and this leads us to ask ourselves how much α may be considered as increased with respect to the values previously deduced, admitting—but not conceding—that the submersible might succeed in maneuvering in a theoretically exact way for arriving at launching position in the minimum time.

If α' is the polar bearing on which the submersible S would be seen from the point P in Fig. 42, the exact value of α is evidently that which corresponds to

$$\sin \alpha' = \frac{V_S}{V_N};$$

that is to say, there must be assigned to α' the values already deduced for α.

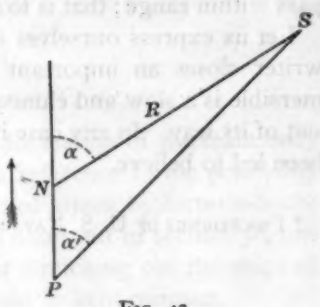

FIG. 43.

Indicating by R the distance NS (Fig. 43), at the beginning of the maneuver of approach, from the triangle NPS we have

$$\frac{NP}{R} = \frac{\sin(\alpha-\alpha')}{\sin \alpha'},$$

from which, substituting for NP and for $\sin \alpha'$ their values, we obtain:

$$\sin(\alpha-\alpha') = \frac{c}{R}\left(\frac{V_N}{V_S} - \frac{V_N}{v}\right)\frac{V_S}{V_N},$$

or

$$\sin(\alpha-\alpha') = \frac{c}{R}\left(1 - \frac{V_S}{v}\right).$$

For the two cases previously considered, the values of $\frac{V_S}{v}$ are respectively $\frac{1}{3}$ and $\frac{1}{4}$; introducing them into this formula, and putting $c = 1000$ meters and $R = 5000$ meters, we get:

for $\frac{V_S}{V_N} = \frac{8}{12}$, $\alpha-\alpha' = 8°$; and hence $\alpha = 50°$ (about);

for $\frac{V_S}{V_N} = \frac{1}{2}$, $\alpha-\alpha' = 9°$; and hence $\alpha = 39°$ (about).

If, then, a submersible is signalled at a distance R from the ship, in order to prevent it from arriving at launching distance, it is

sufficient for the ship to change course through an angle that reaches the maximum values above mentioned.

This is not to be understood as denying the importance to which a submersible may rise—it seems to us that, under present conditions, we may deduce that, instead of relying upon its own maneuvering, the submersible ought generally to wait for the enemy to pass within range; that is to say, *lie in ambush.*

Let us express ourselves in the words with which an American writer closes an important paper on the subject.* "The submersible is a slow and clumsy animal, but its bite is mortal. Keep out of its way. In any case it is not as likely to get you as we have been led to believe."

* PROCEEDINGS OF U. S. NAVAL INSTITUTE, Vol. XXXI.

PART III.

TACTICAL ACTION AS A WHOLE.

CHAPTER I.

Preparation for Tactical Contact.

71. *Route Formations.*—The route formation of the main body of the forces must be established with reference to the possibility of tactical contact with battleships and of attack by torpedo-boats.

As we have already had occasion to point out in section 38, one must bear in mind the necessity of not stretching out the ships of the line in chain; that is to say, they must be kept compact.

Like a fight at close quarters by day, so a night encounter between battleships will certainly not be desirable for the party that is the superior, owing to its interest in avoiding situations in which the unforeseeable is dominant; but it may be advisable for the one who desires to attempt a desperate stroke. It is necessary to guard against such an event, a constant rule being that of not supposing the enemy to be amenable to our designs. Consequently, in order to establish the criteria by which the route formation should be inspired, let us fix our minds on the modalities of the night encounter.

The struggle at close quarters can be its only efficacious form; for this the considerations set forth in section 65 are of value, according to which considerations the route formation must have as a basis the column of vessels, echeloning the ships from it according to the way in which the enemy presents himself. The considerations therein developed must be admitted *a fortiori,* because, naturally, by night, still more than by day, it is indispensable to reduce signals to a minimum and to avoid confusion.

We must hold with Labres (*op. cit.*) that the action of the two fleets will cease when they have passed each other, since a second encounter would imply an inversion of the courses, which must be excluded, owing to the difficulty of recognizing the ships of the two parties. But one must still put himself in condition to draw profit from the disorder of the enemy after passing him. For this

purpose it is well to dispose the forces in two divisions, with sufficient distance between them, so that they need not trouble themselves about the movements that, for each of them, may result from the encounters with the ships or the torpedo-boats of the enemy; these two divisions can then attack in succession.

In this way there is established *the advisability that the principal forces, if numerous, be divided at night into two divisions, rather than massed in a single assemblage.*

The route formation of each division in column of vessels is also the most opportune, having regard to the attacks of torpedo-boats. In fact it is well to observe that the maneuvering of the torpedo-boats will be directed toward executing the attack in such a way as to remain the shortest possible time under fire; therefore, the torpedo-boat will execute the attack upon the first ship that presents itself; and only in the improbable case that he may decide it to have been put out of action will he launch himself against the following ship.

Bearing in mind the characteristic conditions of the night attack of torpedo-boats (section 66), we must recognize that, practically, it is not possible for the torpedo-boats to make a choice of the objectives when the latter are composed—as we now suppose—of ships in motion. The route formation in column of vessels permits, then, the following advantages:

1st. The probability that the torpedo-boats may be in position to attack with opposite parallel courses is rendered minimum; and if this happens, the ships can fire ahead by moving freely out of the column of vessels and toward the opportune side as much as may be necessary.

2d. The maximum defense can be put forth against torpedo-boats sighted off the beam.

3d. The torpedo-boats are also placed in the worst conditions for the withdrawal after launching the torpedoes.

When cruising by night as well as by day in a zone in which the presence of numerous torpedo-boats is probable, aside from the measures for safety of which we shall speak, it must be deemed advisable to navigate at high speed. In fact, the higher the speed, the smaller—as is well known—is the probability of hitting with the torpedo, and the greater the difficulties for the torpedo-boats of executing the maneuver of approach under good conditions.

The cruising system just indicated is applicable, whatever may

be the conformation of the sheet of water that is being crossed. The relative positions of the groups are to be determined according to circumstances; such positions may vary from that in which one division follows the other at a distance, to that of two columns abreast with an interval between the columns of four or five miles; that is, which permits of putting the light artillery and the searchlights freely into action. It is naturally understood that the running lights are obscured, and that the searchlights must be put into action only when the presence of hostile torpedo-boats is signalled.

As Commander Sechi justly observes,* in employing the searchlights "to explore the horizon at more or less frequent intervals, one offers great facility to hostile torpedo-boats; because it is much more difficult for them to find the ships and make sure of their identity than to assail them after having discovered them."

The above-mentioned formation is the one that evidently serves best from the point of view of safety in navigation; it facilitates maneuvering and secrecy, enabling signals to be transmitted between the successive ships of each division by means of a flashlight, visible in a limited sector.

For communication between the two divisions of the naval force the best means of signalling seems to be that of wireless telegraphy, because any others might more easily serve to summon the enemy's torpedo-boats.

The question of the order in which the ships should open fire presents no difficulties with the adopted formation, each ship having a clear field of fire in case of lateral approach, and being easily able to echelon themselves in case of sighting the enemy in the direction of the course. The important thing is that the orders given to the units detached from the main body shall guarantee that the ships or torpedo-boats sighted are those of the enemy; if this necessity is satisfied it can be established that every ship shall open fire as soon as it sights the enemy.

By night as well as by day, the cruising order to be considered as normal for a section of torpedo-boats is that of a triangle of suitable shape, in order that one torpedo-boat may not be enveloped in the smoke of another. The triangular disposition confers the maximum safety in navigation, renders communication easy, avoids the elongations that are produced in the column of vessels, lends itself to the assumption of the opportune alignment

* *Elementi di Arte Militare Marittima*, Vol. II, page 420.

for the attack, and, finally, it permits of grouping in the minimum space, or it is adapted to keeping the torpedo-boats under the support of the ships.

It may be advisable for a flotilla to navigate with the two sections in formation different from that of a column, as Commander Vannutelli has proposed in the article already cited. "In column of vessels and with high speed, it is easy to lose contact, or, *vice versa*, to have dangerous closings in, especially when navigating with lights obscured; that is to say, when about a hundred meters of distance is enough for losing sight of the stern of the preceding torpedo-boat, while in lines abreast or oblique lines it is much more difficult to lose sight of the dark lines of the entire length of the adjacent torpedo-boat. Every one will remember the intense watchfulness and the continual variations of speed that the column of vessels requires by night, which, therefore, in a short time brings great fatigue. With frontal orders the squadron is presented well subdivided into two tactical groups, ready to separate for the opportune maneuver."

72. *Scouting.*—As is well known, we mean by *tactical exploration* that which is exercised by ships in direct communication with the main body, remaining in contact with it at a distance such as to permit a discreet reliance on being able to regain it when it passes to tactical contact with the enemy's battle forces. It is well for this reliance upon the reunion with the main body to be so much the greater, the greater is the tactical importance of the ships employed; that is to say, the greater the importance of these ships, the shorter should be their distance from the main body. Only in exceptional cases could it be desirable for the battleships to sight directly those of the enemy; thus, when in the Chino-Japanese War, Admiral Ito moved in search of the fleet of Ting at the mouth of the Yalu, he was not preceded by any ship, because he aimed at surprising the enemy. But he was able to rely upon the inertness of the Chinese; in general, however, it is presumable that the enemy will maintain a scouting service, especially if he is occupied in operations owing to which he might, by our unexpected arrival, be placed in a critical position; and then comes the necessity of being preceded by ships that will seek to repulse the enemy's cruisers, preventing them from establishing contact with our main body; that is to say, from comprehending the importance of the danger that menaces their fleet.

The importance of knowing beforehand of the approach of the enemy's fleet really exists, as we shall endeavor to show; but it is well to consider in what degree we may be able to satisfy it, if it cannot be presumed in what direction the enemy will be sighted. If we should pretend to form with the tactical scouts a continuous line about the main body, either we should have to employ many units, or the radius of the explored zone would be greatly restricted.

It results from this that tactical exploration, like strategic exploration, must have for its object the search for the main body of the enemy's forces, having regard, however, to certain limits of distance from one's own body. To the end that the warning may not be illusory, it is well to abandon the certainty that the scouts will encounter the enemy before the main body does so, and be content with only a probability. A lookout service tending to establish almost absolute safety over a sufficiently wide sector about the main body is, however, required *when the presence of numerous torpedo-boats can be expected in the sheet of water to be traversed.* In such service the vessels destined for tactical scouting assist; they constitute a first line of defense which, for the reasons mentioned, cannot be entirely relied upon; it is necessary, however, to guard oneself effectively, which can be done in the following manner, on the basis of the deductions of the preceding chapter:

Remembering that the torpedo-boats sighted astern are the least dangerous, it is necessary, by night, to have the naval force preceded and flanked by groups of torpedo-boats at a distance from the main body such that the searchlight of the ships may be operated upon occasion without illuminating them. Each section of torpedo-boats must cruise in compact formation in order to be ready to attack the enemy's forces that it may encounter. The greater cruising speed may be utilized by making these groups traverse a zig-zag with sides suitably inclined to the course of the main body. These torpedo-boats must signal the approach of those of the enemy and try to drive them back, without coming within range of the light guns of their own ships, since every ship must necessarily be able to fire upon any torpedo-boat that approaches it.

In order to exercise vigilance by day against submersibles, it is necessary for the destroyers to keep a lookout ahead and on each

side (up to about 45° from the course) extending themselves in chain. It would be desirable to have a chain at three miles and one at five miles; that is to say, within the limits at which the submersibles must begin the maneuver of approach.

73. *The Reconnoitering of the Adversaries.*—Although it may not be excluded, it is nevertheless not very probable that the fighting forces will sight each other directly; indeed, even admitting that only one of the hostile fleets carries out tactical scouting, when its scouts arrive in sight of the enemy, the latter will detach ships to drive them away, in order to prevent their maintaining the contact; and, as in the case wherein the scouting is carried on by both the adversaries, *an action between cruisers will precede the battle.*

It might be said that this statement is contrary to experience; the encounter between cruisers has not yet been produced, notwithstanding three successive wars; but we can easily give reasons why this may have been the case. For the Chino-Japanese War the consideration already advanced will serve; for the Hispano-American War, the battle took place between a division of four ships and a squadron that was blockading it, keeping with all its ships in close proximity to the entrance of the port. Finally, for the Russo-Japanese War, it is well known that the Japanese main body was constantly preceded by the cruisers; the battle of Tsushima would have begun as above stated if Rojestvensky had had the means of fighting the enemy's cruisers. But, as Semenoff observes in *Rassplata,* the Russian cruisers were either too weak or very old and with insufficient speed. "Furthermore, the admiral desired to save and keep all the elements together; the more so, since, the 12 armored ships being engaged with the 12 Japanese armored vessels, the cruisers would have had to protect the transports and engage by themselves all the rest of the Japanese fleet."

When the encounter between cruisers takes place, the party that has the greater strength in ships of this class, by obliging the enemy's cruisers to turn back, obtains the singular advantage of being able to regulate its own maneuvers of approach on the basis of information transmitted to it; while the enemy remains in uncertainty. In this way there is produced the situation that beyond dispute was realized at the beginning of the battle of Tsushima. Togo, after having stated that his cruisers reconnoitered the enemy without difficulty, adds the following: "These

divisions, although cannonaded from time to time by the enemy, succeeded in preserving the contact, sending by telegraph frequent and precise news concerning his position. And thus, notwithstanding a thick fog that did not permit of seeing further than five miles, we were able to know the position of the enemy, although he was 30 or 40 miles away, as exactly as if we had seen him with our own eyes. . . . . It was thus possible for me to make the dispositions for finding myself at about 2 o'clock near Okinoshima and to attack the head of the column on the port side."

The development of an action of growing importance between the cruisers will induce the main body to detach a sufficient force to complete the *reconnoissance*. In order to fix in our minds how this may happen, let us make use of an example.

A scout has sighted a ship; it moves to observe it and informs the nearest friendly ships of it by wireless telegraph, which ships transmit the news to the commander-in-chief. The suspected ship also has headed toward our scout, so that the recognition is quickly accomplished; the vessel sighted is a protected cruiser of the enemy, weaker than our own, and, consequently, at a distance of not less than 7000 meters it turns to run. The commander-in-chief does not consider this of sufficient importance to alter the course of the main body. The chase of the cruiser continues for some time and our ship gains upon the enemy, so that there is hope of making a good stroke.

A few ineffectual shots have already been exchanged by the two ships, when suspected ships appear upon the horizon, and very soon they are seen to be enemies. It is now the turn of our cruiser to run. It is is well to mention that when our cruiser was increasing its distance from the main body, another ship was moving so as to maintain a chain with it for the transmission of news. When the new enemy's ships are reported, there is then on our part a concentration of a division of protected cruisers in the direction of the adversary; thus we have again a preponderating force and the enemy again turns to run. The course of the main body is somewhat inclined in that direction and the appearance of new ships on the horizon decides us to effect a reconnoissance; that is, to determine if there are other principal forces of the enemy at hand besides those sighted. For this purpose it is determined to send out toward the adversary forces that will not be obliged to

give way except before the enemy's main body; in other words, the armored cruisers are sent forward at that time, at full speed, and the battleships follow ready to support them. The appearance on the horizon of a new division of the enemy still further confirms the idea that important forces are to be found in that direction, and, indeed, in the new division, we recognize the enemy's armored cruisers. The inferiority of the enemy in ships of this type is not slow in producing its effect; the adversary, in order not to be beaten in detail, must turn back and seek the protection of his battleships, that are sighted a little afterward. The object of the reconnoissance is attained; our ships take up a course parallel to that of the enemy and at his speed, signalling to the commander-in-chief the composition and the formation of the enemy's force; our admiral is thus in condition to make the necessary arrangements for attacking the enemy in the most opportune way, or to reverse the course if he does not wish to accept battle. Then begins the contact out of range.

CHAPTER II.

The Battle.

74. *The Importance and Character of Naval Battle.*—As Makaroff writes, "the loss of ten ships in as many combats has not the moral effect of the loss of a squadron, although the number of ships lost may not reach ten."

The destruction of the enemy's movable forces constitutes the essential object at which we must constantly aim; pretending to secure the object of the war by avoiding battle between the forces and seeking secondary objectives is shown by history and deductive reasoning to be entirely erroneous; to us Italians it brought forth Lissa. *A battle desired is greatly preferable to a battle submitted to.*

These axioms, that should be taken as the basis for the strategic employment of the fleet, impose engaging tactically with the enemy's movable forces whenever possible, and, conformably to what we set forth in section 23, they impose engaging to a finish as far as the strategic situation permits.

A characteristic of naval battle is, that in it the constitution of a *reserve* cannot be admitted in the sense that it is understood on land. This difference is easily explained.

On land, when the battle begins, the strength of the enemy is not exactly known; it is not known where his principal mass gravitates; and in order to be in condition to face the situation at the moment it becomes clear, it is necessary to keep available a force to be hurled in an advantageous direction. Moreover, the idea of the gradual employment of the forces is logical, it being that of having troops that serve to support others already engaged, because the latter, besides the losses that they sustain, use up their energy; and hence it is in a high degree important to be able to dispose of fresh troops at the opportune moment, to be despatched in aid of the others.

It is, however, useful for our purpose to remember that even on land it would be dangerous to give too much importance to the criteria just mentioned. "Every reserve," writes Von der Goltz *(La Nazione armata)*, "represents a dead force. Since the simultaneous employment of all the forces brings out the maximum efficiency, it would generally seem erroneous to constitute

reserves; but there is need of them in order to be able to meet unexpected incidents and sudden turns in the combat that are never lacking. If the situation is still more uncertain, if it is believed, for instance, that we may be exposed to many surprises, then strong reserves will be necessary. *The safer the situation*, and the better able we are to estimate concerning the enemy, the weaker the reserves may be. *We can even imagine a circumstance in which it would be logical to proscribe them; that is, when the enemy is completely displayed.* Now, such circumstances will certainly never be realized in practice, and, therefore, we ought never to fight without reserves. It is certain, however, that the opportune reserves are not always the heavy ones, but those that respond to the situation in which we find ourselves."

In the galley period, owing to the fact that a part of the vessels could sometimes be concealed, that the motive power was muscular, and that men fought hand to hand, there were presented conditions analogous to those of battle on land. But to-day the situation is far different; in naval battle we find ourselves in the ideal conditions in which, as Von der Goltz observes, reserves could be excluded even on land.

It might seem advisable to constitute a reserve formed of antiquated ships with scant protection, keeping them on the side of the alignment away from the enemy, and far removed from him so as to safeguard them. Their mission would be to attack injured ships of the enemy that might attempt to withdraw from the combat. But, ideas of this nature, if they were adopted, might bring about a repetition of the conduct of Albini's squadron on the unfortunate day of Lissa; let us remember that it was then said and repeated that wooden ships could not engage with hostile armored vessels. It would be better to leave the antiquated ships in port, or have them previously stricken from the list, rather than take them out before the enemy for the sole purpose of *safeguarding* them and confiding to them an illusory objective.

When it is deemed advisable to take into battle a few antiquated ships, because the offense of which they are capable is not to be despised, and because their speed is sufficient not to lessen the maneuvering qualities of the fleet, it is indispensable that they take a direct part in the battle, and only compatibly with this may they be safeguarded.

More generally, it is well to exclude the idea that while one part

of the ships is fighting, another part may remain in waiting; in such fashion we should offer to the enemy the means of beating our forces in detail; and a disastrous moral effect would be produced in the ships of the reserve. Indeed, let us figure to ourselves what was the state of mind of the personnel of the Russian cruisers at the battle of August 10, 1904, when, after the injuries sustained by the *Askold*, they were placed behind the armored ships.

The supreme importance of the battle demands that all the ships that have the gun for a principal weapon, shall fight from the start, assigning, however, to the various kinds of ships an adequate objective.

It is well known that Nelson, in the memorandum for Trafalgar, alluded to composing a division of the fastest sailers of the fleet, reserving it to himself to indicate, according to circumstances, to which of the two divisions it should join itself; with the intention, however, that the said division should participate in the battle without delay.

The vessels to be kept in waiting are limited to the destroyers and the torpedo-boats. It is not excluded that this light flotilla may render some service (section 69) in the phase of tactical evolutions; during the fleet action it will be kept in opportunely selected coast positions when the battle is developed in proximity to a friendly shore, otherwise they will be kept under the protection of the ships, or at a convenient distance, according to the employment that is had in view for them.

In determining the mission to be assigned to the various kinds of ships, *it must be borne in mind that the issue of the battle depends upon the combat between the armored fleets.* It would, therefore, be absurd initially to withdraw from such category any ship that has protection sufficient for taking part in the principal combat without excessive risk, or that, although having inferior protection (antiquated ships), has a powerful armament; in the latter case it will be placed in the outer line but close to the other ships so as to be able to fire in their intervals.

A few light ships will be necessary out of the line, on the side away from the enemy, in order to repeat signals; it may be advisable to have a repeating ship for every six ships of the line of battle. The other unarmored ships, formed into a fleet independent of the principal one, will have the task of engaging with similar ships of the enemy; so that it is to be presumed that, as at

Tsushima, there will take place a *secondary combat* simultaneously with the principal one.

75. *Contact out of Range.*—The party whose cruisers have established contact with the enemy's main body, according to what is said in the preceding chapter, prepares for battle on the basis of their information; or it alters the cruising formation as may be necessary, and steers so as to sight the enemy from an advantageous position.

If the conditions of visibility were limited, so that the distance of sighting the enemy were within the limit of offensive contact, the advantage in this way would be very great. Nevertheless, under good conditions of visibility the enemy will generally have time to assume an equivalent alignment. The evolutionary phase will then begin.

In Chapter III, of Part II, we endeavored to make it plain that it may be presumed that a phase of active maneuvering will take place out of range, with the object of securing an initial advantageous position. In contrast with the arguments therein adduced there could be cited a phrase of Nelson: "Between two fleets that desire to come to battle, the necessary maneuvers will be few; it will be desirable to make as few of them as possible."

Let us observe that Nelson was referring to the fleet of Villeneuve, which, it was to be presumed, would maintain a passive line of conduct, and that, naturally, he was not neglecting to prescribe the maneuver of approach so as to secure an advantageous position. Under analogous conditions, there is no doubt that the simpler and more rapid the maneuver of approach, the better it will be. Maneuvers out of range are a means of beginning the battle well, and they do not constitute a finality; hence they are absurd if they are not necessary. But if the enemy maneuvers so as to dispute with us the advantageous position which Nelson was not hindered from taking, it will be necessary for us to maneuver also, or resign ourselves to performing the part of Villeneuve.

76. *Offensive Contact.*—After the signal has been made at the beginning of offensive contact to indicate the guiding principle of the maneuver, other signals cannot be absolutely excluded, because it would be absurd for an admiral to renounce expressing his ideas when it is possible and necessary; hence it is natural that there should be battle signals, provided that they are simple and limited in number, and can easily be memorized.

If the commander-in-chief is on a ship in line with the others, he is exposed to great dangers, it being presumable that the said ship will be the principal object for the concentration of fire. But it would certainly not be logical to revert, for that reason, to the solution adopted by the French after De Grasse was made prisoner at the battle of the Saintes, that is, to the system of placing the commander-in-chief on a light ship out of the line—a system they were obliged to abandon.

Tactical maneuvers must, as we know, be based essentially upon the following of movements; so, then, if the commander-in-chief were out of the line, it would be necessary to depend exclusively upon his signals.

To the end that the commander-in-chief may have a well-grounded hope of exercising his directive functions, it is necessary for him to have a means analogous to that which is available on land by means of the reserve; that is, it is necessary for him to have a division under his immediate orders.

Now, we bear in mind that, in tactical maneuvering, the regulating ships of all the divisions are those at the extremities; in order to render minimum the necessity for signals, it is then necessary that there be an admiral at the extremities of the formation of each division. In order that the inconveniences may be minimum in case the commander-in-chief is disabled, it is necessary in such circumstances for his division to continue to be the regulator; that is to say, it is well for the second admiral of the division under the direct orders of the commander-in-chief to be the second in command of the fleet.

It might be held desirable, still satisfying the above-mentioned condition, that, in a line formed, for example, of 12 ships in two divisions of six ships each, the second in command be at an extremity and the commander-in-chief in the center; but we believe he would repent having yielded the position of honor, as Farragut repented it at Mobile.

Having to fight a fleet more powerful than our own, it might seem desirable to seek battle under the forts, in order to find in their support a compensation for our own inferiority. But this would dangerously hamper the strategic employment of the fleet, as well as its tactical employment; and these hindrances might carry with them such detriment as to overbalance the gain in offensive power constituted by the action of the forts.

The issue of offensive contact will not depend upon maneuvering and ability in firing alone, but moral factors will have great part in it.

We can never be sufficiently imbued with the fact—examples of which are not lacking in history—that often one is beaten solely because he is persuaded that he is beaten. Daveluy justly affirms that he who engages in battle with the firm determination of not yielding, is already half a conqueror. On the contrary, he who goes into battle believing that he is accomplishing a useless sacrifice, will hardly succeed in finding energy to give rational direction to the conduct of the forces. Defeat in that case will not be glorious, since, although the situation may be most desperate, there always exists a rational plan to be adopted.

Battle serves to create between combatants differences in order, in material and in morale; in the pursuit we may gather the fruit of such differences and accentuate them in much greater proportion.

The separation of the forces for the pursuit depends upon the separation of the enemy's forces. When, during the night that follows the battle, contact with the enemy is lost, owing to the necessity of leaving a clear field for the action of the torpedo-boats, it will be endeavored, on the following morning, to re-establish the contact, profiting by our conditions of superiority so far as to abandon, at least in part, those precautions that would be indispensable against an enemy in full efficiency. Even the battleships may then be extended in chain for the search.

77. *Tactical Exercises.*—The tactical skilfulness of a fleet can be obtained only through *frequent exercises with parties opposing each other.* As a preparation for these exercises at sea, the tactical game may be profitable; nevertheless, the profitable return of this game is somewhat limited for various reasons, among which are the impossibility of reproducing in them the steering by sight vane, and, more generally, the impossibility of regulating oneself by the enemy in a continuous manner.

To the end that the tactical exercises may be conclusive, it is indispensable that those who are called upon to execute them should possess a sufficient substratum of theoretical knowledge.

THE END.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NOTES ON AVIATION.

By CAPTAIN W. I. CHAMBERS, U. S. Navy.

SAFETY IN FLIGHT.*

The principal factors upon which safety in aeroplane flight depends may be found in three broad groups. (1) Reliable and efficient motive power. (2) Good architecture and careful workmanship. (3) Good airmanship or skillful management.

To my mind, the first two factors may be regarded as sufficiently advanced to insure safety now, although they require further advancement to assure the desired degrees of success. But, as with automobiles, there is a limit to the degree of speed that can be controlled so as to insure the desired degree of safety. The discovery of this limit and the keeping of it within the bounds of safety depends absolutely upon the skill of the airman.

Many aviators are flying without the use of speed indicators, or any other efficient scientific instruments, to warn them when they are in danger and it is probable that many skillful airmen who now depend entirely upon the senses of hearing and touch to warn them of danger, would be able to fly in safety during weather that they are now too prudent to fly in, if it were common practice to use practical and dependable navigating instruments to guide them.

I can readily understand the prejudice that exists among experienced airmen to the use of automatic stabilizers, especially if such devices require adding a considerable weight to the machine. They realize that mechanism is apt to get out of order or to fail at a critical moment and that, at such times, the real bird instinct is necessary to secure safety.

It is apparent from French efforts that their leaders in aviation are seeking to improve safety in flight by an extensive use of scientific instruments to guide or to assist them, and I quote freely

* Portions of this article have previously appeared in *Aeronautics* and the *Aero Club Bulletin*.

some French articles for the purpose of disseminating a more extensive knowledge in this country of two notable French efforts in the direction of safety and of presenting the question of good airmanship in a clear and profitable manner.

To my mind these articles serve to show that the use of such instruments makes for precision in aerial navigation, avoids the folly of haphazard flight and tends to educate the airman in the instincts of the bird.

Bearing in mind the desire to obtain illumination for night use and to embody adjustable electric terminals, for automatic stabilizing, I have in mind a compact design to embody all of these advantages. This design is not complete but, as I have hastily prepared it, will soon be published for comment and criticism. I hope it will stimulate others in this important field to experiment with such a device at the earliest opportunity.

There are two important limits to the speed of an aeroplane, (1) a high speed which it is not prudent to exceed for fear of rupturing the planes, and (2) a low speed, below which the control system will not work to restore equilibrium.

A prudent pilot will always aim to maintain the speed between these two *critical limits* and will keep away from each extreme sufficiently to avoid being thrown beyond either in times of unexpected danger. When the air is disturbed and wind variable, the aerial billows alternately oppose or follow the machine or strike it at varying angles, under which circumstances the limits of critical speed approach each other. In other words, the range through which the speed may safely vary diminishes as the waves increase either in violence or excentricity.

During a flight, with the motor running in a normal way, to each increment of speed there corresponds a certain angle of inclination which is the most efficient for that speed, but it is certain that no danger is risked when the speed oscillates in a sector of which the extreme sides correspond to the critical speeds. The angle or gap of this sector is usually ample and when the air is calm it is easy to keep the speed of the aeroplane within the sector of safety. But when the air is disturbed, the flight becomes more difficult as the amplitude of the sector diminishes.

Also, when the motor power suddenly varies, the angle of the sector diminishes proportionately. The pilot must then execute

a quick maneuver to bring the speed within the more restricted sector of safety; he must be quick to act in case of weakness of the motor and incline the aeroplane to the angle which appears best to maintain equilibrium. Experienced aviators readily feel the position of the machine's equilibrium, but inexperienced aviators are apt to risk their lives in forcing an ascent at starting, or even during a flight, with a motor which works badly. Also, in checking the descent, during a *vol plane*, they sometimes lose their speed and capsize or drop.

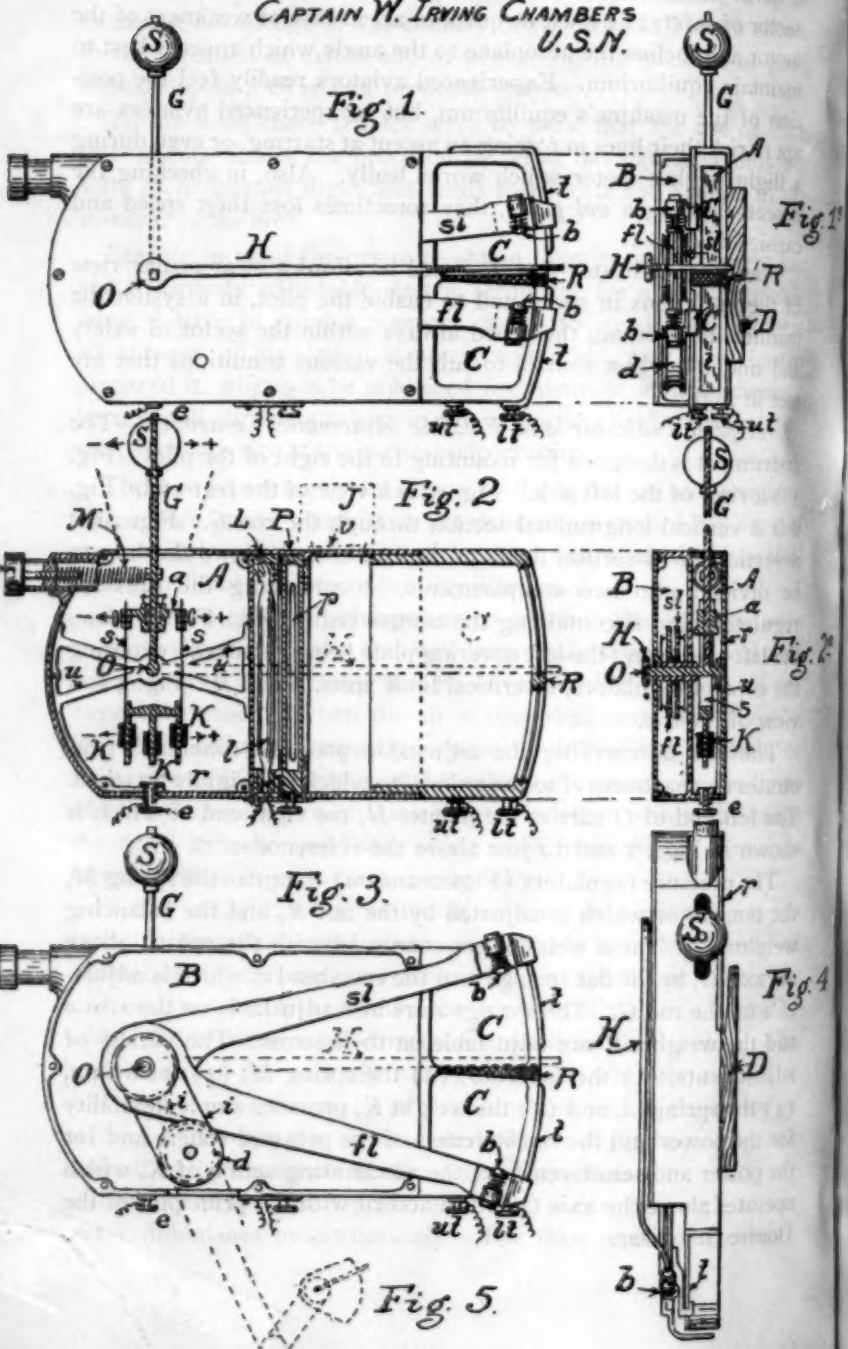
The speed indicator was designed to afford a clear ocular view of the variations in speed and to enable the pilot, in a systematic manner, to maintain the speed always within the sector of safety and under the best control to suit the various conditions that are met in flight.

A Speed Indicator and Flexible Automatic Controller.—The instrument is designed for mounting to the right of the pilot. Fig. 1 is a view of the left side. Fig. 1*a* is a view of the rear end. Fig. 2 is a vertical longitudinal section through the rod *G*. Fig. 2*a* is a vertical cross-section through the rod *G* and shows the box to be divided into two compartments, *A* containing the pressure regulators and *B* containing the control regulators. Fig. 3 shows the left side open (the left covering plate being removed) exposing the control regulators, or critical limit arms, *sl* and *fl*. Fig. 4 is a view of the top.

The rod *G*, carrying the adjustable pressure sphere *S*, penetrates compartment *A* to the axis *O*, to which it is rigidly attached. The left end of *O* carries the pointer *H*, the right end of which is shown in Figs. 1 and 1*a* just above the reference mark *R*.

The pressure regulators (Figs. 2 and 2*a*) comprise the spring *M*, the tension of which is adjusted by the nut *N*, and the balancing weights *K*. These weights are connected with the rod *G*, above the axis *O*, by the flat springs *s*, at the crosshead *a*, which is adjustable on the rod *G*. The springs *s* are also adjustable on the arm *a* and the weights *K* are adjustable on their stems. The variety of adjustments, (1) the sphere *S*, (2) the spring *M*, (3) the arm *a*, (4) the springs *s*, and (5) the weight *K*, provides ample flexibility for the power and the sensitiveness of the pressure sphere and for the power and sensitiveness of the accelerating action of *K*, which operates above the axis *O* and in accord with the principles of the Doutre Stabilizer.

A Speed Indicator
combined with
Automatic Control
by
Captain W. Irving Chambers
U.S.N.



The right side of the instrument carries a covering plate *r* which may be removed to make the adjustments, the brace *u* providing a support for the right end of the axle *O* and also providing direct electric connection between the pointer *H* and the binding post *e*.

An electric light *l* is introduced into the sub-compartment *L* and a rotatable cylinder *p* occupies the adjoining sub-compartment *P*, the bulkhead between them being provided with a slot for the escape of light; *p* is also provided with two slots and the admission of light to the dial sector *C* may be made as bright or as dim as desired by rotating *p*.

In Figures 1 and 3 the critical limit arms *sl* and *fl* are seen, at different angles of separation, extending across the face of the transpartent windows of the dial sector *C*. These arms are made of non-conducting material, such as ebonite, and the rear portion of compartment *B* (that containing the dial sector *C*, see Fig. 3) is also of the same material. The critical limit arms rotate on a sleeve (Fig. 2*a*) which is part of the bulkhead separating compartments *A* and *B*, and the axle *O* rotates, independently, inside of this sleeve.

The rear ends of the arms *sl* and *fl* are provided with metal tips which are grooved and brushed to fit over the metal guide rods *tt* which form separate electric conductors to the binding posts *ut* and *lt*. These metal tips are also provided with spring buffers *b* either one of which, by contact with the metal pointer *H*, as it moves up and down, energizes one or the other of two oppositely rotating magnets (as in the Ellsworth stabilizer), thus rotating the armature and the drum, upon which is wound the elevator wires, and thus moving the elevator either up or down. Contact of *H* with the upper buffer *b* moves the elevator for descent and in the same manner contact with the lower buffer causes ascent. That portion of *H* which passes beyond the point of contact and around the rear windows of *C* is also made of non-conducting material.

If the arms *sl* and *fl* are widely separated, as in Fig. 3, the mechanism provides a wide range for semi-automatic control, the drum upon which the elevator wires are wound may be freely worked by the control lever when the electro-magnets are not energized by the contact at *b*. If *sl* and *fl* be brought near to the reference mark *R*, full automatic control is provided and it is a simple matter to arrange a separate switch, near the pilot, by which the magnets may be rendered inoperative, if desired.

The pilot may quickly adjust the critical limit arms, to suit any conditions, while in flight. By moving a small lever on a dumb sector, such as shown in miniature, Fig. 5, by means of which the drum *d* (Figs. 3 and 1*a*) is revolved, and by suitable belts ii operating corresponding drums attached to the arms *sl* and *fl*, these arms may be moved as desired.

A mounting board *D* (Figs. 4 and 1*a*), adaptable for shaping to any specific location of the instrument, is attached to the right side of compartment *A*.

A 2-inch barometer (or a larger one if desired) with a conspicuous pointer may be neatly mounted above compartment *A*, as indicated by dotted lines at *J*, Fig. 2, receiving its light through a slit, as at *v*, the light being reflected to the barometer dial from a small semicircular reflector, above its face, secured to the housing box.

Thus we combine a flexible automatic stabilizing device, of light weight and sound principles, with an effective speed indicator which is always adjustable to suit the conditions of flight and is always available for use in event of motor derangement. Reserve tanks and batteries to work the stabilizer in case of motor derangement are, therefore, superfluous with this device.

The variable speed friction control would work well with this device and the generating power for operating the wireless is sufficient to work the stabilizer as well as the self-starter, the speed indicator always remaining as the main reliance when the automatic power is cut out.

Now that the French have secured an enormous sum for additions to their aerial army, some anxiety is being manifested in the public press as to the fitness of their machines, notably in *L'Eclair*, *L'Aurore* and *Le Figaro*, and attention is being focussed upon means for securing ***safety in flight***.

To my mind there is no need for apprehension, although I have long felt that in matters of such importance false moves should be avoided, as far as possible. I am convinced that reasonable safety in flight can be assured in the best American machines, by the general use of certain mechanical agencies which are already on the market, and that the inherent stability of aeroplane as well as the reliability of motors will steadily improve.

Nevertheless, it is evident that apprehension is felt in France, in quarters where least expected, and, although it is also evident

that those who are directing affairs and who are best informed are doing the correct thing, there is danger that a panicky feeling may result in a serious blow to the art of aviation during its most critical phase.

As an example of the sentiment in some quarters the following quotations are extracted from a contribution by "X" to *La Technique Aeronautique*, April 15, 1912:

Lately the public demand, as voiced by debates in Parliament, was for an annual sum of not less than 75 millions (francs) or enough to acquire a fleet of 1000 aeroplanes.

Inspired by the efforts of Germany, is was said, France cannot go slow without danger of losing a supremacy dearly acquired. We believe that there is in this manifestation many illusions which are dangerous to manufacturers as well as to aviation.

We have seen that Germany is conservative in devoting a more modest, but still a considerable sum to the creation of an aerial fleet. They surely understand the military value of aeroplanes as engines of reconnaissance, but they also recognize that to pilot 1000 aeroplanes 1000 aviators are necessary. We now possess no more than a hundred, civil and military, capable of rendering the practical services demanded of them in time of war. As for the Germans they regard aviation with a cold and positive enthusiasm and they know very well the hour has arrived to show their confidence in those who are qualified to make the conquest of the air a reality.

Now, in France, we are beginning to show that we no longer believe that the conquest of the air is an accomplished fact, because each week increases the number of mourners over the martyrs to aviation. If we are not careful it will be aviation itself for which we will be in mourning.

Civil opinion is indicated by the fact that the number of aeroplanes purchased for public use is gradually decreasing. If the public becomes *blasé* in the matter, as it is very near to being now, public sentiment will close the purse and condemn aviation *en bloc*. It is ominous that manufacturers no longer wish to race, notwithstanding the large prizes offered. For the want of something convincing, all that concerns aviation is under suspicion.

The reflections of the public run something like this:

What change has come over the machines since Bleriot crossed the channel?

The effective performances are due to the pilots not to the machines. They are obtained at the cost of a veritable squandering of motive power, of money and of human life.

The exhibitions (*salons*) follow one another, but they are all alike.

When a pilot has made a fortune he gives up his place to others. What a singular symptom! Certain constructors who were revealed as marvelous pilots and who had their triumphal march in the *debut* of aviation, no longer pilot their machines in the great trials.

One hesitates long before writing about things of fear and of injury to

the grand cause of aviation, but it should do no harm to discuss these matters, for everyone knows the blue side of the facts and it will not do to ignore what has already gained public notoriety.

It was announced in advance that *great revelations* would be made at the last military competitions. Everyone knows that the great revelations did not materialize. Why was no greater improvement shown? Is the industry dead or is it true that further progress is impossible? Public opinion hesitates between these two questions.

The great improvement that is demanded is safety.

To affirm that accidents are due to the blunders of pilots, to wind eddies, to "holes" in the air, is no solution. That is only shirking responsibility and there is attached to it a serious flareback.

To put it mildly we cannot take liberties with the good sense of the public. The public does not wish to become an acrobat to avoid being killed in an aeroplane and it is now time to design the machines to "master wind eddies and 'holes' in the air."

All of this seems hysterical, but it is valuable as a sign-post showing which road to take and which to avoid.

The same journal states editorially:

Current opinion, very characteristic and very emphatic, pronounces more and more in favor of researches having for their object the safety of aviators.

The *Union for Safety* comprises representatives of all the societies, happily very numerous, which are interested in the future of aerial navigation, such as the Aero Club of France, the General Aeronautical Association, the Syndicated Chamber of Aeronautical Industries, the Automobile Club of France, the National Aerial League, the French Society of Aerial Navigation, the Touring Club of France, etc.

The delegation of this Union, having at its head M. de la Vaulx, was lately received by the Minister of Marine, who assured its members of his co-operation and who promised to take up without delay, with the Ministers of War and Public Works, the consideration of the best measures for the expenditure of a sum of 500,000 francs donated to reward inventors and constructors who could assure the safety of flying machines in an efficacious manner.

This is an eminently useful work and of the greatest urgency. We should not, however, count on the immediate production of perfect machines.

As soon as a means for diminishing the chances of accidents has been found it should be immediately applied to our avions. Public interest is excited in favor of all aviators but those for whom aviation has become a military duty are entitled to special consideration.

The Presidents of the syndicates for War material and Naval Construction, and the Committee of Iron Industries and Railroad Material have placed at the disposal of the Ministers of War and Marine the sum of 150,000 francs, subscribed by their patrons, to be applied to naval and military aviation. In response to the intentions of the subscribers this sum is

donated to the Government with full discretion for employing it in solving the problem of *safety* in aerial navigation.

To my mind the sums above mentioned should be credited to M. Eiffel, M. Doutre and Captain Etévé.

The following comments on the fact that Prince Henry of Prussia had opened up an aviation subscription list similar to that lately completed in France appear in the same journal:

The German tendencies are very instructive and we should watch them very closely. . . . The most important things recognized are, above all, the *quality* and the *safety* of the machines much more than the *number* and *quantity*.

In the same number of this publication appears an article by one of the pioneers of aeronautics, Commandant Paul Renard. I hope that this article will do something towards hastening the more general use, in this country, of mechanical aids for safety in flight.

The safety of aviators rightly concerns all who are interested in aerial navigation. The frequency and the gravity of accidents, independently of humanitarian considerations, is deplorable from the point of view of aeronautical progress and requires us to seek the means, wherever to be found, for avoiding or for limiting the consequences.

One of the most troublesome causes of catastrophy is that of instability of aeroplanes. An aviator takes flight, he rises without difficulty, travels over the atmosphere at great speed; all seems going well when, suddenly, the machine rears, or plunges by the head, or it tips over on one side, then quickly falls to earth crushed with its human freight.

What are the causes of these mysterious accidents? They are wind gusts, "holes in the air," it is said. Almost always the caprices of the atmosphere are accused, sometimes it is the strength of the apparatus and sometimes false maneuvers are blamed.

How can we discover the cause? Those who investigate find on the earth only a mass of wood, cloth and steel wires mixed up with fragments of motor and propeller. In the midst of this chaos is the victim. All the explanations given are extremely inaccurate, but that which is certain is that it happened, in the midst of most satisfactory flights, from *unforeseen* circumstances which compromised the stability of the apparatus either in a longitudinal or in a transverse direction.

All technicians agree in saying that an ideal aeroplane should, when its equilibrium is disturbed, in one direction or the other, re-establish its balance automatically. Most of the existing aeroplanes possess this property to a certain degree, but the re-establishment of equilibrium requires a certain *time* during which the aeroplane almost always approaches the earth. If it is not sufficiently high up, it strikes before being able to recover the normal position. This is already one cause of frequent accidents, but there are others.

The stability of existing aeroplanes is generally limited, *i. e.*, they recover their normal positions only on condition that they do not pass a certain inclination. Furthermore, they are "compromised," that is to say, they have passed their zone of stability and instead of returning to their normal positions they incline more and more. The *chute* and the unexplained death follows.

A skillful pilot can immediately combat ruptures of equilibrium by convenient maneuvers. If they are always made in time, he is certain not to pass the limits of stability and will avoid the compromising position.

Unfortunately, it requires great skill always to maneuver opportunely and with the necessary rapidity, even the best of pilots may tire and grow careless. At other times the disturbing causes may be unexpected, manifested in a manner or at a time when the pilot is already fatigued or manithem. ...uy too late to combat

Several persons have endeavored to ameliorate this situation by providing the pilot with mechanical agencies for his guidance. Some, like Captain Etévé, recommend the use of indicators which inform the pilot of the modifications in the behavior of the apparatus which he could not otherwise perceive soon enough and notably as to the changes in speed with respect to the surrounding air. Thus warned, the pilot can execute, in proper time, the maneuvers that without the instrument he would have performed, perhaps, too tardily.

M. Doutre goes further, his apparatus does not indicate the maneuvers which must be done, it executes them. His apparatus is a real automatic stabilizer.

The inventor has concerned himself, so far, with longitudinal stability only, but it is understood that he expects ultimately to master the problem of lateral stability.

His apparatus moves the elevator and modifies the longitudinal inclination of the aeroplane automatically. These movements are controlled by two distinct and separate organs, an accelerator and anemometer.

The accelerator acts in obedience to the *absolute* variations in the speed of the machine. When, from whatever cause, the forces which drive the machine forward are augmented, the speed tends to increase, but, by virtue of its inertia, the center of gravity of the machine does not obey, instantly, the increase in force and there results, according to the conditions of the increase, inclinations either up or down which may become dangerous.

M. Doutre combats them in a convenient way by maneuvering the elevator, which maneuver is controlled by the displacement of the accelerator, the position of which, with respect to the aeroplane, is influenced by the accelerations, positive or negative, and which move the elevator through the medium of the valve on a servo-motor operated by compressed air.

In the other case it is not the absolute speed which changes, but the *apparent* speed or the *relative* speed with respect to the surrounding air. If this speed increases no great inconvenience is caused. The trajectory rises more or less by reason of the increase in the sustaining force and, at the end of a certain time, conditions are established which do not give serious concern.

It is not the same, however, if the apparent speed diminishes. Then the sustaining power becomes insufficient and the machine seeks the earth, but at the same time its longitudinal equilibrium is compromised. It is necessary, at all hazard, to render the relative or apparent speed normal, and, to this end, to have recourse to an auxiliary motor which is always ready to speed up and which is no other than the *weight of the machine.* In other words, it is necessary to incline the machine in such a manner that it will follow a descending trajectory at such a slope that the action of the weight combined with that of the motor, which alone would be insufficient, restores the normal speed.

For this purpose the Doutre stabilizer carries a plate of *palette* perpendicular to the axis of the aeroplane which constitutes an anemometer measuring the relative speed. When that speed exceeds the normal the *palatte* is immobilized, but in the contrary case it is displaced under the combined action of the springs and the air resistance and, by its displacement, moves the elevator so as to cause a descent and thus increases the speed.

If the accelerator and the anemometer work in consonance their combined effect in moving the elevator, is to increase the movement. If, on the contrary, their respective impulses are contrary their combined effect is to decrease the movement.

The conception of such an apparatus is eminently rational, but it is important to remember that M. Doutre has no thought of presenting his stabilizer as a universal *panacea* for assuring the longitudinal stability of a machine that is deficient in stability. No, the inventor expects the aeroplane to be as stable as possible, but as the ordinary stabilizing influences act slowly, if they are always relied on occasions will occur when the equilibrium will be re-established too late. It is necessary to anticipate the perturbations and to execute quickly the maneuver required to return to the normal position.

All the slow perturbations will be corrected by the disposition of the aeroplane surfaces themselves. The rôle of the stabilizer is essentially that of intervening in case of rapid perturbations.

In regard to the mathematical theories of M. Doutre which have been developed in an interesting manner, one can raise several objections in detail. I am assured that most of the expressions in respect to aeronautical terminology are not sufficiently fixed and that M. Doutre employs some which depart a little from general usage. But these are criticisms of form and not of foundation.

The best argument in support of M. Doutre's conception is the prolonged experience, and to my mind it is conclusive as to the value of his stabilizer. For several months it has been used on machines of which the stability is not ideal and under atmospheric conditions often troublesome. The results have always been excellent, and I can only wish the greatest success to the Doutre stabilizer and base upon its employment the greatest hopes for the safety of aviators.

In an address delivered at the inauguration of the Aerodynamic Laboratory of Auteuil, March 19, 1912, M. Eiffel, after describing

how he overcame some of the difficulties connected with the very successful work in his laboratory at the Eiffel Tower, on the Champ de Mars, made the following significant remarks:

I intend to follow up my researches on stability, already commenced. This is a subject of primary interest in aeronautics at present. It is an obstacle which must be overcome, for the good of aviation, and I am confident of our success.

I am confirmed in my belief, among other reasons, by the results actually obtained by M. Drzewiecki, who, guided solely by our experiments at the Champ de Mars, has arranged a disposition which realizes automatic longitudinal stability. This was tried out the other day with a model carefully made to the 1/10th scale and freely suspended in horizontal equilibrium at its center of gravity around which it could oscillate in the air blast of the laboratory. Under these conditions the equilibrium was disturbed in various ways and the model returned instantly and very positively to the normal position. The experiment was very encouraging.

One of Mr. Eiffel's recent interesting discoveries is a confirmation of the results obtained by Professor Langley with respect to the inherent stability of his successful motor-driven model with tandem planes. M. Eiffel has found that when the planes are properly located and proportioned and the rear plane set at an angle of 2½ degrees with the front plane, the longitudinal stability is improved and the sustentation is even greater, at certain angles of inclination, than that of a monoplane of the same area.

In view of all the facts and accomplishments up to date it seems to me that the outlook for *safety in flight* and the sane progress of aviation is very bright and that the spirit of unrest in France on the subject of safety is more of a healthy indication than otherwise.

LANGLEY DAY.

An address delivered on Langley Day, May 6, 1912, at Chevy Chase Club, under auspices of Aero Club of Washington.

In reviewing the subject of aviation on Langley Day, from a naval viewpoint, it is appropriate to quote the trite words of a recent writer,* as follows:

Warfare to-day is a question of science against science, of education and training against education and training. It is largely an engineering proposition and is altogether an economic and a business proposition.

This quotation would be equally true if the word *aviation* were substituted for *warfare*.

* Mr. Hudson Maxim in *Aircraft*, May, 1912.

In view of the valuable pioneer work of Langley, under the auspices of the government, for the scientific development of aviation, why is it that the name of Langley and the value of his work is so little appreciated among his countrymen generally? The reason is this: He was so absorbed and zealous in his work that he had little time or inclination for providing representatives of the press with the usual pabulum that would enable these agents of popular demand to furnish the necessary thrills of sensation demanded by the average reader. The result was that, in spite of his success, the few hitches that occurred were placed before the people in a disadvantageous light and even held up to ridicule.

Nevertheless, his work and his fame and, incidentally, the credit that belongs to the country through his efforts are honored abroad, if not at home.

Now what caused the revival of aviation in this country? It was public interest in the achievements of the Wright brothers, not so much through what they accomplished here as what they and Glenn H. Curtiss demonstrated abroad. The American public was awakened then by the pride of American success in competition abroad, and the press has ever since endeavored to supply the demand for startling feats of American prowess to such an extent that the *scientific* aspect has been overshadowed by the *spectacular*. The result is that without the same encouragement in development for military purposes that has been given abroad, through natural causes, this noble art, which is so pregnant with engineering possibilities is regarded largely, in this country, as finding its most useful application here among the acrobats and hippodrome performers.

This, to my mind, has diverted attention from the most useful sphere of aviation and in some respects has done more harm than good.

What is the naval viewpoint of aviation and what has been accomplished?

Before making use of this new art it was clearly desirable to demonstrate whether or not aeroplanes could be used successfully in scouting, in communicating between a fleet commander afloat and a commanding general on shore, and whether or not they could discover an enemy's submerged mines and torpedo craft.

That all this will be possible is now practically assured. The eyes of the fleet may thus be extended far beyond the old limits

at a comparatively small outlay. But the machine must be such as may abide with the ships for the sake of the constant instruction, training, tests and demonstration that are necessary in order to make efficient use of them in the maneuvers. The first thing to accomplish then was to obtain vehicles with which constant training could proceed from the ships themselves, surrounded as they usually are, by ideal aerodromes, the water.

This could be done satisfactorily by the hydro-aeroplane or "airboat" only, and it is gratifying to note that in this respect we have led the world. I may say, in fact, that little interest was manifested in naval aviation abroad until the success of our small beginning was known there. Very recently, it has been taken up seriously and actively in France, England, Germany, Russia, Italy and Japan.

Some good scientific work has been done in the investigation of hydroplane models at the Naval Model Basin here in Washington, and this basin has demonstrated that it is a fine asset to the development of aviation in this country.

These models are being tested on the three machines that have been purchased from our small appropriation, and tests of wireless or radio apparatus are proceeding in conjunction with other experiments and the little instruction we can give with a small outfit, before such machines are issued to the ships for service use.

In the second place, it was natural that a mariner should regard with skepticism any effort at aerial navigation while yet there existed any doubt as to the possibility of directing a flight accurately from one point to another, over sea or at night, or in a fog.

Little attention has been paid by believers in aviation generally to the fact that an aviator was unable to navigate, under such circumstances (except in a calm) by the ordinary mariner's compass, notwithstanding the lamentable example of Cecil Grace, an American, who was lost about a year ago, while endeavoring to fly across the English Channel in a fog. There are officers in the navy to-day who look upon naval aviation as farcical because they do not yet know that an instrument can be provided by which an aeroplane may be navigated out of sight from a ship at sea with a reasonable surety of her being able to go where sent and to return to the ship that sent her.

But this important instrument, the airship compass, is now practically assured through the efforts of the American Navy in the development of naval aviation.

The next point to be sure of was that of *reliability* in long flights, which has chiefly to do with the improvement of motors, and, although it is now only a very close approach to an accomplished fact, it is a purely scientific problem and one which, through my knowledge of what is being done in the United States today, leaves no room for me to doubt that a fully satisfactory development may be looked for in the near future.

The last point is the question of *safety* in flight. The advent of the airship compass will practically settle the navigational aspect of this question, but from the maneuvering standpoint that of semi-automatic control, combined with good airmanship, something remains to be done. The solution is clearly evident to my mind and rests with a more general use of scientific instruments in the control of equilibrium. The machines are sure to be improved in stability but are safe enough at present if the instruments, already available for the safe control of equilibrium, were used by those aviators whose ambitions lead to greater fields of usefulness than those of acrobatic stunts. In long flights, flying will be safe when the aviator is able temporarily to be relieved from much of the physical tension and strain of uncertainty by the use of scientific mechanical agencies. In my opinion, aviation will soon be as safe as automobiling, and its sphere of usefulness will be extended far beyond the limits of good roads.

Now, aviation in this country and naval aviation in particular has had a fair beginning only, and no further substantial progress can be made, in competition with other countries, until we continue the work inaugurated by Professor Langley on scientific lines.

It is pertinent to note that some of the results obtained by M. Eiffel very recently, at his aerodynamic laboratory in Paris, confirm the discoveries of Langley in a remarkable degree. I refer particularly to the tandem arrangement of planes which, in Langley's motor-driven model, showed great longitudinal stability. This arrangement has appealed to me for some time as possessing features sufficiently advantageous for airboats to be worth investigation, but I have been met by clouds of mathematical demonstrations, by both English and French investigators, tending to prove a theoretical inefficiency of this arrangement. Now comes M. Eiffel, with the facilities of his laboratory, to make it clear that when such surfaces are properly proportioned and set at a proper distance apart, if the following surface is set with its chord at a

negative angle of 2½ degrees with the leading surface, the longitudinal stability is improved and the sustentation is not only equal to that of a monoplane of the same area, but for certain inclinations is greater, and Langley's work is vindicated beyond expectation.

In an address to the 5th International Aeronautic Congress, at Turin, August 11, Commandant Renard, President of the International Aeronautic Commission, stated that *aerodynamic laboratories* have existed for several years in different countries, and he noted that they exist in the United States, having in mind, of course, the world renowned work of Professor Langley and believing that it still continued at the Smithsonian Institution.

To revive and continue this work in accordance with the spirit of foreign progress, the establishment of a modern national aerodynamic laboratory is necessary. The facilities here in Washington exceed those of any other country in the world. It is possible to establish here, at a comparatively small cost, an ideal institution which will co-ordinate the work, not only for the best interests of commerce and business, but for the best interests of both the army and the navy.

This, in my opinion, is one of the most important steps yet to be taken and, when inaugurated, the laboratory should be dedicated to the memory of *Langley*.

THE LATEST DISCOVERIES OF M. EIFFEL.

Notwithstanding the importance of the results obtained last year by M. Eiffel, in his aerodynamic laboratory at Paris, his recent discoveries, at the same place, promise more for the progress of aviation than any other information obtained throughout the year.

ASPECT-RATIO AND CENTER PRESSURE.

The results of his latest experiments show the relation between the efficiency of an aeroplane wing and its aspect-ratio. The efficiency of a wing of given curvature increases with the aspect-ratio of the wing until the aspect-ratio of 6 is reached. The results are nearly the same for the aspect-ratios of 6 and 9, and it does not seem that there is any advantage, therefore, in designing a wing with a span greater than 6 times its chord or depth.

In last year's disclosures he showed that the position of the center of pressure of a curved surface gradually moves forward

towards the leading edge, as the angle of incidence diminishes, until a certain inclination is reached, when it travels backward towards the following edge as the angle of incidence is further diminished. The angle at which this change in the travel of the center of pressure takes place has been designated "the angle of retrogression" and, for a curved surface, has now been found to vary with the aspect-ratio. Thus, for a particular surface it is found that with an aspect-ratio of 6 the angle of retrogression is 15 degrees, that it is 30 degrees when the aspect-ratio is 1 and 60 degrees when the aspect-ratio is $\frac{1}{6}$.

The general conclusion is that for inclinations of the chords of the surfaces beyond 15 degrees—such as are met in the practice of aviation—the center of pressure travels towards the following edge as the angle of incidence diminishes.

The lack of longitudinal stability in many existing aeroplanes has been ascribed to this cause, and it was in search of a remedy that a wing curvature has been sought whereby the center of pressure would not travel backwards in this manner. M. Eiffel's discoveries now confirm the claims of the Italians in respect to the flexible rear edge of the Antoni machine and of others. He finds that, in the case of wings having a double curvature, the back portion of which is turned upward, the center of pressure for small angles travels in a direction the reverse of that of ordinary surfaces with single curvature, *i. e.*, for small angles of inclination the center of pressure travels forward as the angle diminishes and backwards as the angle increases. This is important, as it increases the natural stability of the machine. If for some reason during a flight an aeroplane with a double curvature wing suddenly dips forward, the angle being diminished, the center of pressure travels forward and tends to restore the machine to its original inclination. If, however, the inclination is suddenly increased, as by an upward puff of wind, the center of pressure moves to the rear to restore equilibrium.

But these surfaces of double curvature have a relatively small "lift co-efficient," and he shows that this is also true for surfaces which embody varying angles of chord inclination.

Experiments with a single curvature wing, having chords varying regularly and continuously from the center line towards the lateral edges, show that, for all practical purposes, the position of the center of pressure is constant within the limits of inclination

which interest practical aviation. This is due to the fact that the center of pressure of the whole wing is the resultant of the combined centers of pressure of the different parts making up the whole wing. But, as before stated, the experiments show that wings with varying angles of inclination, although more stable, are not very efficient. This result is what one would naturally expect because the different portions of such wings do not work together simultaneously for efficiency at the best inclination.

TANDEM WINGS.

One of the most interesting discoveries is this late vindication of Professor Langley's work, notwithstanding the volumes of mathematical fog that have been evolved to show that tandem planes are unstable and inefficient.

Some of M. Eiffel's interesting experiments prove that when curved wings are made to move in tandem it is possible to obtain a displacement of the resultant center of pressure in a direction contrary to that of the single wing and that it is possible thus to obtain the efficient lift co-efficient of "unvarying" surfaces and at the same time to increase their longitudinal stability.

Three different arrangements are referred to, but in all cases the wings were of a circular curvature with a maximum camber of 1/13.5 of the chord, and they had a span of 90 cm. (35.4") with a depth of 15 cm. (5.9"). In the first arrangement the two wings were parallel to each other and the chords were in the same plane. In the second the chord of the following surface made a negative angle of 2½ degrees with the chord of the leading surface. In the third arrangement the chord of the following surface made a negative angle of 5 degrees with the chord of the leading one. In all three cases the distance between the following edge of the leading surface and the leading edge of the following surface was twice the depth of either surface.

In the first arrangement the displacement of the resultant center of pressure is found to be similar to that of a single curved surface, *i. e.*, for small angles of incidence it moves backwards as the inclination diminishes. The second and third arrangements, however, show that the center of pressure, instead of retrograding as in the preceding arrangement, travels forward, a result which is advantageous for longitudinal stability. The second arrangement (2½ degrees negative for the rear surface) is the better, its sustenta-

tion being equal to that of a monoplane of the same area, and for certain inclinations it is even greater.

STAGGERED PLANES.

Two series of experiments were made with regard to staggered planes, with the following results:

(1) It does not seem advantageous to stagger biplanes for the purpose of improving sustentation.

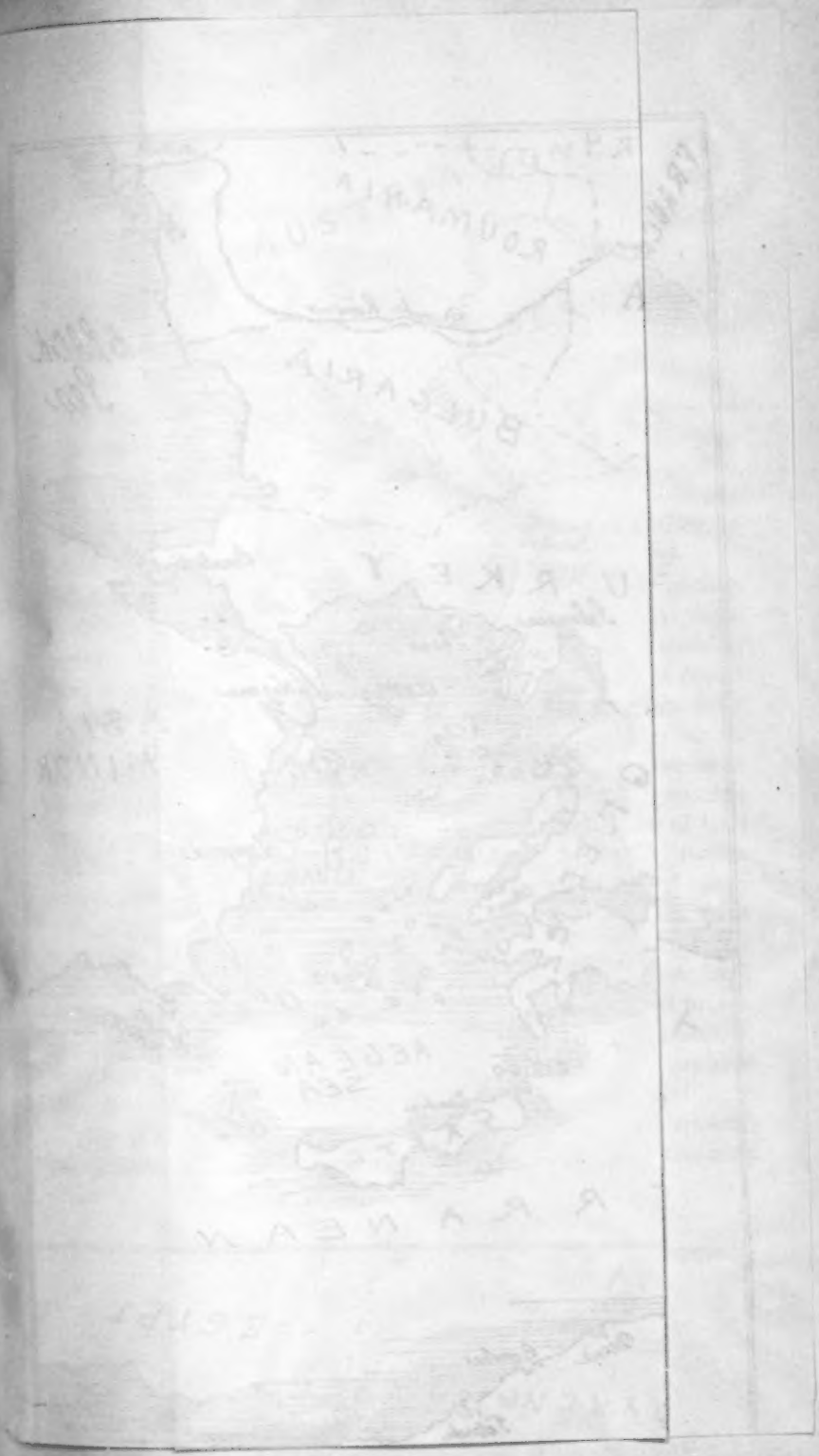
(2) A great gap, or distance between superposed surfaces, is advantageous so far as lift is concerned.

THICKNESS OF WINGS.

To determine the influence of wing thickness on the lift and drift, comparative experiments were made with three wings, the curves of which were arcs of circles and the greatest mean heights of camber were 1/13.5 of the chord.

The models of these wings were 10 mm. (.39″), 14 mm. (.55″) and 18 mm. (.6″) thick respectively at their central section and the thickness of corresponding full-sized wings ten times the model scale would be 10 cm. (3.9″), 14 cm. (5.5″) and 18 cm. (6.0″) respectively. Examination of the results relating to the three wings shows that for all inclinations the thinnest wing has the smallest drift for a given lift and that it also has the greatest lift. However, the advantages of the thin wing are not so great as to prevent increasing the strength of the wing by slightly increasing its thickness.

The distribution of pressure on the under as well as on the upper surface is practically the same in all three cases, and this is also true with respect to the variation in the position of the center of pressure.



FRANCE
Genoa
Spezia
Venice
Trieste
Fiume
AUSTRIA HUNGARY
ROUMANIA
RUSSIA
SERVIA
BULGARIA
Danube River
Black Sea
Corsica
Elba
Ancona
Rome
Sardinia
Naples
Bari
Taranto
Brindisi
Cattaro
Montenegro
Durazzo
Valona
Adriatic
TURKEY
Salonica
Thasos
Lemnos
Nagona
Mytilene
Chios
Smyrna
Samos
Rhodes
Cerigo
Crete
Candia
Canea
Ionian Sea
Greece
Aegean Sea
Mediterranean
Sicily
Palermo
Messina
Augusta
Trapani
Marsala
Malta
Tunis
Sfax
Tripoli
Homs
Khoms
Derna
Bomba
Benghazi
Tobruk
Cyrenaica
Solum
Egypt
Tripoli
SCALE 1:10 000 000

THE ITALIAN-TURKISH WAR.

By COMMODORE W. H. BEEHLER, U. S. NAVY (Retired).

(Compiled and translated from the *Marine Rundschau*, and other sources.)

Italy declared war against Turkey for commercial reasons and to provide a neighboring colony for her surplus population. The Italians believe the prediction of the great African Explorer, Gerhard Rohly, who, twenty years ago, declared that the power that rules Tripoli will dominate the Soudan. The proximity of Tripoli to Italy makes its possession desirable.

The importance of the region was recognized by the ancient Romans. Cyrenaica was very important. The five great commercial ports were known as the Lybian Pentapolis, and existing ruins of great works, aqueducts, dams, and large buildings reveal its ancient prosperity. Sallust states that Leptis alone annually exported forty million bushels of grain and paid a war tax of twenty-five thousand gallons of olive oil. The Mediterranean climate prevails, and though the great Saharan Desert approaches close to the coast there are large oases and fertile tracts of land that would enable the country to support a population of twelve million inhabitants, whereas it now has but one million.

This coast has a number of naturally fine harbors that have been filled up with sand and ruined by neglect, but which could easily be reclaimed. Such are Tripoli, Lebda, Misrata, Benghasi, Derna, Mersa, Bomba and Tobruk. The trend of the coast brings the Tripolitan ports three hundred miles nearer the trade centers of points around Sahara, and the trade routes converge towards Tripoli.

Ever since the Kingdom of Italy was united Italy has coveted the adjacent coast of North Africa. Forty years ago Bismarck wrote to Mazzini: "The Mediterranean is indisputably Italy's sphere of interest. The control of the Mediterranean should be the constant goal and the controlling principle of Italian statesmen!" England had long possessed Malta and Gibraltar. In 1878 she acquired Cyprus while Austria took Bosnia. At the Berlin Congress

Bismarck and Beaconsfield offered Italy Mythelene, Tunis and Tripoli; but Cairoli declined, stating that he wished to leave the Congress with clean hands. Other nations, however, stepped in and took forcible possession. France inaugurated her Algerian imperial policy and acquired Senegal, Tschad, and Tunis. France fortified Biserta on the Tunisian coast and is now proceeding to peaceably acquire Morocco. During the Russo-Turkish war England offered to form a league with Italy, Austria and Greece to maintain the *status quo* in the Mediterranean, but Italy declined because she did not wish to disturb her friendly relations with other nations. In 1881, when France seized Tunis and broke the *status quo,* Italy claimed to be too weak to make any serious protest but, at the renewal of the triple alliance in 1866, Italy complained that Germany and Austria did not protect Italy from French encroachments in the Mediterranean. Bismarck then is said to have negotiated a secret treaty with England stipulating that Italy's interests in the Mediterranean should be preserved. In 1889, however, England negotiated the Soudan treaty with France defining boundaries that encroached still further on the borders of the Tripolitan hinterland. In a secret treaty in 1902, England and France recognized Italy's claims to Tripoli. In 1904 France definitely proclaimed Italy's prior right to take possession of Tripoli under certain contingencies. During the Bosnia-Bulgarian crisis Italy was supposed to take definite action but Italy hesitated because of England's relations with the Young Turk government, but since England's attitude has cooled somewhat, Italy has finally acted to be no longer reproached for neglecting her opportunities. These diplomatic incidents explain the present neutrality of European powers.

The Turks have had possession of Tripoli since 1835, and the inhabitants regard Turkish rule as a blessing; they have enjoyed greater freedom and have been subjected to much less burdensome taxation than before. The protectorate of Tripoli is an expense rather than a source of revenue for Turkey. The expenses of administration are greater than the revenue from harbor dues and agriculture. The Turks relieved the people of military service at first, but in 1901 universal compulsory military service was re-established and occasioned some opposition, but this has been long since settled as a necessary feature of the government. The alleged Italian claim that the country is misgoverned and that intolerable conditions exist are not well founded.

The Berbers were the original inhabitants of the entire North African Coast as far as Morocco. These were joined by a large emigration of Jews after the Babylonian captivity. The Jews number about 20,000 or one fiftieth of the estimated population of one million. These Jews live in the cities and are the leading merchants, a few carry on small industries in the interior. The Arabs invaded, not in great hordes but by single tribes, from time to time, when compelled by famine to leave their former abodes. These tribes captured places from the numerically superior Berbers who were scattered, and gradually they have amalgamated so that it is rare to find either pure Berbers or pure Arabs in the country. The negro population is estimated at 50,000. There are 15,000 Spaniards; 50,000 Turks, Armenians and Albanians; 3000 Maltese, and only 1000 Italians; the rest are Berber-Arabs.

The Turks are chiefly officials or in the army. The Armenians and Maltese compete with the Jews in the trade. The Italians are far behind all other traders. They have a flour mill, an oil mill, one soap factory and an asparagus press, which are supported by the Bank of Rome at a loss. The export trade with Italy is valued at $600,000, while the imports from Italy only amount to $400,000 per annum. England has the bulk of the commerce.

The population is extremely fanatical and bitterly opposed to the Italians. The All-Islam propaganda has aroused the religious fanatics, who are so extremely bigoted that they do not regard the Turks as true Moslems, and some of the opposition to the Turkish rule was because the Turks are not orthodox Mahomedans. The fact might be used to favor the Italians if managed with a delicate diplomacy, but the conciliation of the people is a very difficult task.

The country is agricultural and can only be made profitable by developing its agricultural resources. Tobacco, cotton, silk, olives, wine and dates could be profitably cultivated but such can hardly be expected of the Italians, who have failed to agriculturally develop Italy, and in all countries to which Italians have emigrated they are rarely found to be successful agriculturists. The negro is much better qualified for this development, and even more so are the Berber-Fellachens, who are acclimated and familiar with conditions of the soil.

Tripoli is important because of the possibilities of its hinterland, though much of the important trade that would have its natural outlet through Tripoli has been secured by France through Algiers

and by England through Egypt. The boundaries of the English and French spheres of influence in the Soudan and around the hinterland of Tripoli limit its importance to the coast.

Italy has a precarious problem in the conquest of this hinterland. France has operated under most favorable conditions to develop her Algerian policy and in the last ten years after indefatigable labor France has succeeded. How will Italy manage is problematical. Italy has a most formidable foe in the tribe of Fessans who, though numerically inferior and provided with inferior weapons, are thoroughly accustomed to the hot, dry climate, are a warlike race, very mobile, and possess a knowledge of the country that will outweigh the superiority in numbers and equipment of the Italians. Racial sympathy and the fanatical religious zeal will add to make them almost invincible in the defence of their native land. Guerilla warfare will be sure to prolong the war should the Italian armies overcome the organized defence so that the peaceful agricultural development must be long deferred. Finally trade relations with the interior will cause friction in Italian competition with the English and French; and influence relations of the European powers.

England with her chain of naval bases at Gibraltar, Malta, and Suez Canal communications has regarded the Mediterranean in a measure as a *Mare Clausum* and she cannot favor the establishment of formidable ports on the other flank of this line. The British Mediterranean fleet has of late years been reduced and greater attention been given to the North Sea, whereas now the Mediterranean will require more attention. England and France will increase their Mediterranean naval forces while Italy will lean more than ever upon the Central European powers and the triple alliance, in which Germany is so much interested, will be strengthened.

ITALY'S AVAILABLE NAVAL FORCES WHEN WAR WAS DECLARED.

THE SEA-GOING FLEET, VICE-ADMIRAL AUBRY, COMMANDING.

1ST SQUADRON, VICE-ADMIRAL AUBRY, ORGANIZED FOR WAR.

1ST DIVISION.

Battleship,	Vittorio Emanuele, flagship.
"	Regina Elena, joined Oct. 5, 1911.
"	Roma.
"	Napoli.

2D DIVISION, REAR-ADMIRAL PRESBITERO.

Armored cruiser,	Pisa, flagship.
"	Amalfi.
"	San Marco, joined Oct. 1, 1911.
"	San Giorgio, repairing in Spring, 1912.
Torpedo ship,	Agordat.
Minelayer,	Partenope.

2D SQUADRON, VICE-ADMIRAL FARVELLI, COMMANDING.

3D DIVISION.

Battleship,	Benedetto Brin, flagship.
"	Regina Margherita, joined Oct. 5, 1911.
"	St. Bon, subsequently transferred.
"	Emanuele Filiberto, ready Sept. 30, 1911.

4TH DIVISION, REAR-ADMIRAL THAON DI REVEL.

Armored cruiser,	Garibaldi, flagship.
"	Varese.
"	Ferrucio.
"	Marco Polo, subsequently transferred.
Torpedo ship,	Coatit.
Minelayer,	Minerva.

DIVISION OF TORPEDO BOAT INSPECTOR.

REAR-ADMIRAL, DUKE OF ABRUZZIA, COMMANDING FOR WAR.

Armored cruiser,	Vettor Pisani, flagship.
Battleship,	St. Bon, transferred from 3d division.
Armored cruiser,	Marco Polo, transferred from 3d division.
Prot. cruiser,	Lomdardia, submarine's mothership.
Destroyer,	Artigliere, from destroyer flotilla.
"	Fuciliere, " " "
"	Corazziere, " " "
"	Alpino, " " "
"	Zeffiro, " " "

High sea torpedo boats, four to eight, from destroyer flotilla.

TORPEDO FLOTILLAS OF THE SQUADRON.

320 tons,	Ostro,	first division.
"	Freccia,	" "
"	Lampo,	" "
"	Euro,	" "
330 tons,	Nembo,	second division.
"	Turbine,	" "
"	Borea,	" "
"	Aquilone,	" "

416 tons,	Alpino,	third division.
"	Pontiere,	" "
"	Carabiniere,	" "
"	Fuciliere,	" "
400 tons,	Bersagliere,	fourth division.
"	Granatiere,	" "
"	Garabaldino,	" "
"	Lanciere	" "

DESTROYERS IN RESERVE.

330 tons,	Zeffiro,	at Spezia.
"	Espero,	" "
400 tons,	Artigliere,	at Tarento.
"	Corazziere,	" "
320 tons,	Strale,	at Venice.
"	Dardo,	" "
300 tons,	Fulmine,	at Leghorn, schoolship.

28 high sea torpedo boats.

TRAINING SHIP DIVISION, REAR-ADMIRAL BOREA-RICCI, COMMANDING.

Battleship,	Sicilia, flagship.
"	Sardegna.
"	Re Umberto.
Armored cruiser,	Carlo Alberto.

OTHER AVAILABLE NAVAL VESSELS.

Coast defence ship,	Dandolo,	forming a fifth division.
" " "	Italia,	" " " "
" " "	Lepanto,	" " " "
Protected cruiser,	Elba,	Red Sea.
" "	Puglia,	" "
" "	Etna,	" "
" "	Liguria,	" "
" "	Pimeonte,	" "
Gunboat,	Governolo,	" "
"	Gal. Galilei,	station, Constantinople.
Minelayer,	Tripoli,	at Venice.
"	Goito,	" "
"	Montebello,	" "
Torpedo ship,	Urania,	at Naples and Spezia.
" "	Iride,	" " " "
" "	Caprera,	" " " "

Coast torpedo boats, about 60 in all

Submarines, 5 at Brindisi, 2 each at Spezia and Venice.

AUXILIARIES.

Collier,	Bronte.
"	Sterope.
Transport,	Citta di Milano.
"	Carigliano.
"	Volta.
Repair ship,	Vulcano, at naval base, Augusta.

SHIPS STATIONED ABROAD.

Gunboat,	Arethusa,	in the Red Sea.
"	Volturno,	" " " "
Survey ship,	Stafetta,	" " " "
Prot. cruiser,	Calabria,	in East Asiatic waters.
" "	Etruria,	in American waters.

TURKEY'S AVAILABLE NAVAL FORCES ON SEPTEMBER 15, 1911.

BATTLESHIP DIVISION.

Battleship,	Babarossa Heireddin,	(91)	10,060 tons
"	Torgut Reiss,	(91)	10,060 tons

CRUISING SQUADRON.

Prot. cruiser,	Hamidje,	(03)	3800 tons
" "	Medjidije,	(03)	3200 tons

TORPEDO BOAT FLOTILLA.

Destroyer,	Jadighiar-i-Millet,	(09)	620 tons
"	Nemune-i-Hamie,	(09)	" "
"	Muavenet-i-Millije,	(09)	" "
"	Taschos,	(08)	305 tons
"	Basra,	(08)	" "
"	Samsum,	(08)	" "
"	Yar Hissar,	(08)	" "
Torpedo mother,	Tir-i-Mugguian,		4052 tons

RESERVE DIVISION.

Battleship,	Messudije,	(74)	(03)	9250 tons
Coast defence,	Assar-i-Tewfik,	(68)	(99)	5700 tons
" "	Feth-i-Buelend,	(71)	(07)	2800 tons
" "	Awnllah,	(69)	(07)	2400 tons
Destroyer,	Pelenghi Deria,		(94)	900 tons
"	Berc-i-Sawet,		(07)	750 tons
"	Gairet-i-Watanije,		(09)	620 tons

DETACHED TORPEDO BOATS.

Anatalia,	(06)	160 tons
Takat,	(06)	" "
Ursa,	(06)	" "
Ankara,	(06)	" "
Dratz,	(06)	" "
Kutahia,	(06)	" "
Mussul,	(06)	" "
Alpagot,	(04)	" "
Al Hissar,	(04)	" "
Abdul Medjid,	(01)	145 tons
Junus,	(01)	" "
Hamid Abad,	(08)	97 tons
Sivri Hissar,	(08)	" "
Sultan Hissar,	(08)	" "
Timur Hissar,	(08)	" "

STATIONED IN HARBORS.

Coast defence ship, Muin-i-Zafer, (71) (07) 2800 tons, Beirut.
Destroyer, Peik-i-Schewket, (07) 750 tons, at Hodeida.
24 gunboats of 200 to 650 tons.
20 coast torpedo boats of 40 to 85 tons.
6 special ships of 180 to 2300 tons.

THE TURKISH GARRISONS IN TRIPOLI AND CYRENAICA.

The Turkish Army stationed in Tripoli and Cyrenaica was composed of the 42d Division consisting of, viz:

4 regiments of infantry = battalions of 600 each.
1 battalion of chasseurs.
2 regiments of cavalry = 10 squadrons of 80 to 120 horses.
1 regiment of field artillery = 6 batteries of 4 to 6 field guns of 7.5 cm., or 3-inch guns.
4 companies of engineers.
3 companies of fortress artillery.

The complement was 12,000, but at the outbreak of the war the trained troops numbered about 5000 infantry and 400 cavalry with about 2500 to 3000 raw recruits.

The garrison of the city of Tripoli consisted of:

6 battalions of infantry with two machine gun companies.
1 battalion of chasseurs.
6 field batteries.
4 squadrons of cavalry.
2 companies of fortress artillery.

This organization called for 6000 troops, but at the outbreak of the war there were but 3000 trained troops with about 2000 raw recruits.

The garrisons in other parts of the province were distributed in small detachments. It is reported that just before the war Benghasi had 400; Derna, 70; Tobruk, 30; Solum, 25, and Cyrene 10 men.

In addition to these regular troops the territorial troops were organized in 30 battalions of infantry and 60 squadrons of cavalry with a total strength of 20,000.

These combined gave a total strength of the Turkish forces at 28,000 men.

The regular infantry was until recently armed with an old model of Mauser rifles, but recently they have been supplied with the latest model of Martini rifles, and the Mauser rifles have been given to the irregular troops. During the latter part of September about 10,000 of these old Mauser rifles were sent into the interior for the territorial troops. The Turks have 50,000 rifles and ample ammunition.

THE DEFENCES OF THE CITY OF TRIPOLI.

The defences consisted of five old coast fortifications and some newer earthworks on the land front. On the west side Fort Sultanje and Fort Gargaresch comprised a group of three old earthworks carrying modern Krupp guns. Italian reports state that these included some 21-cm. howitzers. Fort Sultanje protected the cable landing from Malta. There was a group of old stone forts near the town on the north, there consisted of: (1) The Lighthouse Fort whose walls were mounted with three old 15-cm. guns with the lighthouse built on the same wall; (2) The Spanish Fort on the harbor mole, and (3) Fort Rosso, west of the Lighthouse Fort (so-called because of its red walls). Forts 2 and 3 were armed with old small-caliber guns.

Fort Hamidije or Scharaschat is about 6000 yards east of the city on a bluff fifty feet above the sea level, an old earthwork that commands the outer roadstead and the harbor. The four modern guns which were formerly mounted in this fort were taken to Yemen in 1905 and replaced by four old howitzers. Latest reports state that the Italians found one 24-cm., one 15.2-cm. and one 9-cm. guns in this fort. Field Marshall von der Goltz states that in 1911 the defences of Tripoli had no guns larger than 15 cm., made in 1870.

A wall 25 feet high, built in the 16th century, encloses the inner city. The land forts encircle the town in a series of earthworks commanding the roads leading into the country.

THE MILITARY CONDITIONS AT TRIPOLI.

The lack of heavily armed modern fortifications and the weakness of the garrison, with the easily interrupted line of communication with Turkey, rendered any attempt to defend the city from an oversea attack by the Italians hopeless at Tripoli, and even more so at the other ports.

The defence was still further hampered by lack of food. The Turkish-Tripolitan troops had long been subsisted by commissary stores from Constantinople. The failure of the crops in recent years was such that the Turkish government was also obliged to subsist the poor people. The starving people were supplied with rations from two large tents at the gates of the city.

The Egyptian railroad only extends about 200 miles west of Alexandria with its terminus at Mersah Matruh, which is about 800 miles from the city of Tripoli, so that the Turkish request of England for permission to send Turkish troops to Tripoli through Egypt could not be of much practical value.

It would have been better to have organized Turkish defence against the Italian invasion back from the coast. Field Marshall von der Goltz claims that the real defence of Tripoli is in the interior. The regular forces, though few in number, would be insufficient. The resistance must depend chiefly on the native population, especially with the support of the Shiek Sidi-es-Senoussi, who had been recognized as the ruler of Djarabul, on the borders of Barka. The Shiek of Senoussi at first hesitated to oppose the Italians.

ORGANIZATION OF ITALIAN-TRIPOLITAN EXPEDITIONARY CORPS.

The partial mobilization of the Italian army for the Tripolitan expedition was with the 7th and 12th Italian army corps, chiefly from the cities of Palermo, Rome, Naples, Florence, Verona, Milan, and Turin. Entire regiments were taken from these cities, and volunteers increased the regimental strength to the war footing of 2600 men. The standing army was reinforced by calling out the category of reserves of 1888. 80,000 reserves were thus added to the army stationed at home.

The expeditionary corps consisted of the following:

COMMANDER-IN-CHIEF: LT.-GENERAL CANEVA DI SALASCO.

CHIEF OF STAFF: MAJOR GENERAL GASTALDELLO.

FIRST DIVISION OF INFANTRY, LT.-GENERAL COUNT PECORI GERALDI.

1st brigade.	*2d brigade.*
82d infantry.	6th infantry.
84th infantry.	40th infantry.
3 squadrons of cavalry.	6 batteries field artillery.

SECOND INFANTRY DIVISION, LT.-GENERAL BRICCOLA.

3d brigade.	*4th brigade.*
22d infantry.	4th infantry.
68th infantry.	63d infantry.
3 squadrons of cavalry.	6 batteries field artillery.

Under direct command of expedition commander:

The 8th regiment Bersaglieres.	1 battery mountain artillery.
The 11th regiment Bersaglieres.	Several batteries field artillery.
One battalion of engineers.	One telegraph company.
One machine gun detachment.	Wireless telegraph personnel.

A company of infantry has about 200 men so that the total force was about 40,000 men. They had 11 flying machines of French types. The Italian infantry had a 6.5-cm. repeating gun of Mannlicher-Carcano type M-91. Each soldier carried 162 cartridges besides which the transports had 24 cartridges per man additional. Each company carries 105 intrenching tools of which 80 are spades. The transports had 144 intrenching tools per battalion additional.

The Italian field artillery had 7.5-cm. Krupp guns M-1906. The troops had a special grayish-green uniform. After September 27th the Italian railroads were crowded with troops assembling for the expedition. A smaller detachment of troops was embarked in the transports at Naples, Syracuse and Augusta on September 26, to be ready for emergency.

DECLARATION OF WAR AND NOTICE TO NEUTRALS.

At 2.30 p. m., September 28, the Italian Chargé d'Affaires in Constantinople presented the Italian Ultimatum to the Turkish government. This declared that in order to terminate the disorders and neglect caused by the Turkish Government in Tripoli,

and Cyrenaica, the Italian government demanded that Turkey should, within 24 hours, consent to Italy's military occupation of those provinces. The Turkish government refused and at 3 p. m., September 29, the Italian government declared war between Italy and Turkey.

The Italian government proclaimed its purpose to take prompt measures for the protection of Italians and all foreigners in Tripoli and Cyrenaica.

Neutral powers were notified that the Tripolitan and Cyrenaican coast were blockaded.

Within a few days France, Russia, Belgium, Spain, Portugal, Servia, Bulgaria, England and Japan issued neutrality proclamations.

The French declaration of neutrality stated that it comprised the French protectorates including Crete. The English and Russian governments endorsed the French proclamation, and Italy was freed from the protection of the Island of Crete.

The orders of the Turkish government to extinguish the coast lights and remove sea marks on the coast of Crete were annulled by the united action of all consuls in Crete before the neutrality proclamations.

England declared the island of Cyprus neutral, and issued orders for all British subjects not to serve in the armies of the belligerents. In the middle of October Italy recognized the neutrality of the island of Samos.

THE ITALIAN NAVAL PROBLEM.

Before the war began Italy notified her ministers to the Balkan states that Italy's only object was to take possession of Tripoli and Cyrenaica, and she would avoid any attack upon any other Turkish territory. The destruction of Turkey's naval and military forces was only contemplated in as far as they opposed Italy's conquest of Tripoli and Cyrenaica.

The Italian naval task was to secure such a command of the sea that the expedition corps might safely be transported and landed on the African coast and communication with Italy be undisturbed.

This task furnished three fields of operations:

1. The Tripolitan waters, by which the expedition corps would land. The bulk of the navy was employed there.

2. The eastern Mediterranean, especially the Aegean sea where

the Turkish fleet had assembled and which must be prevented from interfering with the landing of the Italian forces. For this purpose light scouting vessels were used.

3. The Albanian coast where a number of Turkish torpedo-boats should be held in check. For this some older armored cruisers and several destroyers were used.

EVENTS ON THE TRIPOLITAN COAST AFTER DECLARATION OF WAR UNTIL THE ARRIVAL OF THE EXPEDITIONARY CORPS.

The Italian government declared a blockade of the coast of Tripoli and Cyrenaica extending from the Egyptian to the Tunisian borders. Violations of the blockade would be prosecuted according to International law and Italian treaties with other powers.

The blockade of the coast, 700 nautical miles, was made effective by 7 battleships and a number of destroyers and special ships. Ships of the blockade replenished fuel supply by going to Augusta singly as necessary. At the outbreak of war Italy had stored 14,000 tons of coal at the naval base at Augusta. The naval repair ship *Vulcano* was stationed at Augusta.

After some discussion the Turkish forces at Tripoli decided to evacuate the city with the exception of 150 coast artillery stationed in the forts. The troops began the evacuation September 27, and quietly proceeded to intrench in the hills south of the city and two days march distant. The Italians were kept informed of all that transpired in the city through the Mayor, Prince Hassuna Karamanli, who had declared his adhesion to Italy.

September 30 the Italians demanded the city should be surrendered on October 2, but this was still further postponed until October 3, at noon. No reply having been received Vice-Admiral Faravelli, in command of the naval forces, opened fire on the forts.

The *Benedetto Brin* and the training ship division, with two transports and several torpedo-boats arrived and relieved the *Roma, Pisa, Napoli* and *Amalfi* that had been blockading Tripoli, and which left to join the flagship to the eastward.

THE BOMBARDMENT OF TRIPOLI, OCTOBER 3 AND 4, 1911.

In the bombardment the *Sicilia, Sardegna,* and *Re Umberto* were assigned to engage Fort Sultanje on the west; the *Benedetto Brin, Carlo Alberto,* and *Emanuele Filberto* engaged the three old stone

forts on the sea side; and the *Garibaldi* and *Ferrucio* engaged Fort Hamidje.

The *Varese, Coatit,* and 16 destroyers and four auxiliaries were stationed to the rear and on the flanks to prevent any surprise from seaward.

Fire was opened at 3.15 at range 7000 meters, by the flagship. The forts replied immediately but all their shots fell short. The Italians fired chiefly with the 15 and 20-cm. guns, and they soon proved effective. The heavy guns were not used, probably to preserve them and avoid too much expenditure of ammunition. The hits were few and the fire very slow, many shells failed to explode and were subsequently picked up several thousand yards beyond in the suburbs.

The old stone forts ceased firing at 5 p. m., but the two outer forts continued firing until sunset, at 6 p. m.

Though the buildings in the city were avoided, fires were started in several, and the governor's palace was hit a number of times. The new lighthouse was completely destroyed. After dark the ships got under way and cruised in the offing with screened lights.

At 6 a. m. the bombardment was resumed with greater vigor, and the other forts were silenced in the following hour. Fort Sultanje made the greatest resistance. Ten dead were found in that fort subsequently.

OCCUPATION OF TRIPOLI BY THE NAVAL LANDING FORCE.

While the mob in the city sacked the government buildings, the garrison evacuated the forts taking their light guns to the heights in the southern suburbs, from which they reopened fire but were soon silenced by shrapnel from the ships. The ships ceased firing at 11 a. m. The *Garibaldi* was the first ship to enter close in and she landed a detachment with two officers in Fort Hamidje that had been evacuated by the Turks. They rendered the breech mechanism of the guns therein useless and returned on board.

At the same time a torpedo-boat searched for the cable of mines laid out in the harbor but could not find it.

All the coast forts were severely damaged and their guns partly dismounted. According to Turkish reports their garrison lost 12 men killed and 23 severely wounded. Seven civilians were killed in the city, but no Europeans. The Italian ships suffered no losses nor any damage from the Turkish fire.

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At noon, October 4, the large ships anchored in the offing and smaller ships entered the harbor. October 5, a landing force of 1200 men under command of the captain of the *Sicilia* ocupied Forts Sultanje, Hamidje and the Lighthouse Fort, as well as the consulate and other important places without any opposition. The Italian flag was hoisted on Fort Sultanje at noon and saluted by the fleet. Shortly after this Fort Hamidje's magazine blew up and that store of Turkish ammunition was destroyed. It is not known if this was done by the Italians or by the Turks.

The landing force immediately arranged for the defence of the city and established its government. Rear-Admiral Borea-Ricci was appointed provisional governor, and the former mayor, Hassuna Karamanli, was appointed vice-governor.

They proceeded to substitute a temporary lighthouse for that which they had destroyed. The cable to Malta was repaired and preparations were begun to provide quarters for the expedition corps that was expected to arrive October 11.

A native police was established, and by offering payment, some of the natives were induced to surrender the arms with which the Turkish officials had supplied them. Within a few hours 1500 Mauser rifles were deposited with the Italian officers, and by October 12, 3250 rifles had been delivered.

During the next day when the *Garibaldi*, *Varese*, and *Ferrucio* had departed for Augusta to coal, the landing party ashore had several skirmishes with the Turks. October 8 they repulsed an attack at Behare, and October 19 another attack at Bu Meilana Wells, about 1.5 miles southwest of Tripoli. As Fort Sultanje was much exposed the Italians abandoned it and it was blown up. The ships supported the troops during these engagements and bombarded the Turkish forts used as bases beyond the suburbs.

The Turkish garrison assembled at Gharian in the hills, two days march from Tripoli. General Munir Pasha was relieved by Colonel Neschat in command during the middle of October, who gathered all the forces of the province. At first he had a force of about 10,000 regulars and 10,000 territorial irregulars, the latter volunteering for the war.

Tobruk, on the Cyrenaica coast, a fine natural harbor was attacked by the first squadron on October 4. A force of 400 men landed and soon overcame the brave resistance of the garrison of 25 men. The Italians took possession and established an Italian

municipal administration. Single ships of the first squadron alternately remained at anchor in that harbor. October 10 the first detachment of the expeditionary army landed at Tobruk. This was the first battalion of the 40th Infantry, with some coast artillery and engineers—about 1000 in all. They had sailed from Naples October 6.

Derna was bombarded October 8, and 40 Italian citizens who were confined there were released. The place was bombarded because they had fired upon the Italian boat with flag of truce.

EVENTS ON THE ALBANIAN COAST.

Before the war six new Turkish torpedo boats were at Prevesa, Gomenitza and Durazzo to prevent smuggling. They had not received orders of the Turkish Naval Minister to take refuge in Austrian ports when they were attacked by the destroyers of the Duke of Abruzzia's command.

At 3 p. m., September 28, one hour after war had been declared the Italians sighted the two Turkish torpedo-boats, *Takat* and *Anatalia*, at sea between Corfu and Prevesa, steering northwestward. The Italians opened fire, to which the Turkish boats replied feebly. The *Takat* steered north followed by three destroyers. while the *Anatalia* steered south chased by two destroyers. The *Takat* was hit 15 times and on fire, she ran on the beach near Nikopolis and was totally destroyed. Her commander and 8 men were killed or drowned. The *Anatalia* escaped to Prevesa uninjured. The Italian destroyers were not damaged in this action. They fired 100 shots from 7.6 cm. guns.

September 30 the Italian destroyers *Artigliere* and *Corazziere* attacked the Turkish torpedo-boats *Alpagot* and *Hamid-Abad* lying at anchor at Prevesa, and sank them. An officer from the *Corazziere* having landed the night before had definitely ascertained their positions. The Turkish crew, excepting one man, escaped. The destroyers then entered the harbor. The mob on shore fired on the *Corazziere* as she proceeded to take the steam yacht *Tetied* out. The *Corazziere* fired at the mob and both destroyers left with the steam yacht in tow.

The fort at Prevesa is an old stone fort built during the Venetian period, but armed with 20 modern field guns and five 6-inch Krupp guns. This fort did not fire on the Italians, though the

latter fired 76 shells during the engagement that lasted 45 minutes. The garrison was surprised.

This gave rise to exaggerated rumors of attack and landing of Italians at Prevesa, which the Italian government denied and repeated the orders to avoid landing on any Turkish territory in Europe. The Duke of Abruzzia was directed to revoke his threat of a bombardment of Prevesa within 24 hours, on October 3, if the gunboat and two torpedo-boats in Prevesa were not delivered to him. At the request of the Austrian government the Italians recalled the Duke of Abruzzia with all the Italian ships from that coast.

October 5 a motor boat of the destroyer *Artigliere*, that had been searching an Austrian mail steamer in the harbor of San Giovanni, was fired on by some field guns in an earthwork at the place. The *Artigliere* had not yet received the orders to return to Tarento and she opened fire on the earthwork, and in the course of 45 minutes expended all her ammunition. She silenced the fort and injured a number of buildings in the city. The *Artigliere* was slightly damaged and her commander was wounded. In the meanwhile the *Carabiniere* arrived and opened fire on the earthworks, and left after firing for a period of 20 minutes. After these events the Italian government again declared that every possible precaution should be taken hereafter to avoid all warlike operations in the Adriatic sea.

October 7 the Duke of Abruzzia's squadron again proceeded to blockade the Turkish torpedo-boats in their ports on the Albanian coast.

EVENTS IN THE AEGEAN SEA.

The Italians sent but small naval forces to the Aegean sea, chiefly scouting torpedo vessels. September 30 a panic was created at Smyrna, Salonica and Mythelene by the appearance of passing Italian warships. Probably the *Victoria-Emanuele, Roma* and *Pisa* on a cruise, searching for the Turkish practice squadron.

In Constantinople fears were entertained for the safety of the Turkish practice squadron that had sailed from Beirut at 10 a. m., September 28, for the Dardanelles. This squadron was composed of 2 battleships, 2 cruisers, 9 destroyers and a torpedo-boat mothership. They had no knowledge of war having been declared. The squadron steamed at economical speed to the south-

west coast of Cyprus, practicing evolutions en route. Near the island of Kos, at 4 p. m., October 1, a Turkish government steamer informed them of the war. The British officers in the squadron then decided to remain on board until their arrival at the Dardanelles. The squadron then proceeded at full speed between Mythelene and the mainland, and safely anchored at Nagara in the Dardanelles that evening.

Vice-Admiral Williams of the British navy and other British officers left the squadron. On October 4 the squadron made a short cruise out of the Dardanelles but returned the next day, and anchored off Constantinople and remained there until October 16. In the meantime the harbors of Salonica, Smyrna, Beirut, and the approaches to the Dardanelles were mined. Single Italian cruisers were seen in the Aegean sea on October 4 and 6. Three Italian destroyers appeared off Mythelene on October 15.

THE TRANSPORTATION OF THE ITALIAN EXPEDITION CORPS.

The Italian Navy Department collected 60 steamers of 1300 to 9200 gross tonnage at Naples, Palermo and Genoa. A naval officer was in command of each transport with 25 sailors of the navy. Those transports that were subventioned as auxiliaries for war were armed. All the details of embarkation, loading, and routes for the single transports or in a fleet were successfully kept a profound secret. The expedition corps was divided into two divisions. The first division was sent to Tripoli and the second to the ports of Cyrenaica.

The van sailed in five transports from Genoa, via Naples, on October 6 for Tobruk with some troops and material of the second division, and arrived October 10.

October 9, transports sailed from different Italian ports. 12 transports with the staff of the expeditionary corps and the first division with nine additional transports sailed from Palermo for Tripoli. Within Italian waters the fleet steamed in single column of vessels, with cruisers and torpedo boats ahead and on the flanks. After leaving the Sicilian coast they formed double column, and in two groups, the one with 19 transports and the second group of 14 transports. Speed was 10 knots. Two battleships and several destroyers were in the van, and likewise two battleships in the rear with more torpedo destroyers.

Destroyers also were disposed to form a chain of outposts

along the course between Tripoli and Augusta, the naval base. The first squadron was stationed in the passages from the Aegean sea to the Mediterranean to prevent any interference by the enemy's squadron. The naval commander-in-chief was, at the departure of the convoy, at Augusta.

Good weather was experienced and the first group arrived at Tripoli October 12; the second group arrived October 15. These were preceded by the *Varese* convoying two transports and a hospital ship.

The disembarking was accomplished by means of the ships boats with a large number of large fishing smacks from the island of Lampedusa. The landing proceeded at Tripoli without interruption. The troops from the first group were all landed by October 15, and those of the second group by October 18, a total of 20,000 men being landed from the two groups.

Immediately upon landing the army took the positions held by the naval landing parties, and especially the entrenchments at the 14 wells of Bu Meliana, which had been the repeated object of attack by the Turks. The engineers immediately began work on building entrenchments around the city. The army was promptly engaged with the Turks who made night attacks on Bu Meliana on October 15, 16 and 18, both sides suffering losses in killed and wounded.

October 13, 20 transports sailed from Naples with the second division, about 9000 men, and arrived at Benghasi October 18, having experienced bad weather on the passage. This convoy was escorted by four battleships of the first division, three cruisers, one destroyer and the two seagoing torpedo-boat divisions. They landed at Benghasi, after overcoming the weak resistance of the Turks, on October 19. This group was followed by transports that left Naples between October 15 and 20 with the rest of the Second Infantry Division, about 6000 men. With these the transportation of the expedition corps was practically completed.

(CONTINUED IN NEXT ISSUE.)

DISCUSSION.

Inspection Duty at Navy Yards.

COMMANDER A. B. HOFF, U. S. Navy.—There are two things that strike one forcibly in Lieut.-Commander Parker's article. The first is that he presents in a clear and altogether readable form, every detail of what an inspection officer's duties should be, if carried to their logical limits under the present arrangements. The second is, to my mind, that the Admirable Crichton does not exist with the expert knowledge these arrangements demand.

In saying this I do not say an inspection system is not needed, because it is obvious that it *is* needed. I refer merely to the present arrangements for that work, with an eager hope that the problem may be solved to the betterment of the fleet.

The Inspection Department has been created for efficiency. Efficiency is the best work necessary (not better than is necessary), for the least money. I believe no one will deny that this system has increased efficiency. There remains, therefore, the task of further increasing it. To do this a stimulus has to be provided. Shall the stimulus proceed from without or from within?

Thus far, in the navy, there have been numerous examples of both kinds, but the best have been, and undoubtedly will be, those proceeding from within. I may cite the cases of our tremendous strides in gunnery, in engineering, in the economical use of stores, and in self-maintenance of ships.

The difficulties to be met, in applying such methods to increasing our navy yard efficiency, are apparent to any naval officer.

To mention a few—civilian workmen, difficulty of comparison in cost, and even in excellence of work, due to difference of labor market, climatic conditions, supply of material and industrial conditions, and temporary conditions in the distribution and immediate necessities of the fleet.

As a beginning the present inspection officer and his staff are the result. It is only fair to suppose that modification and progress will take place in this system, and that all are desirous of that result. Otherwise discussion would be out of place.

There is no doubt that this beginning has been pregnant of vastly useful results, in that it has turned the minds of those responsible into the desired channels. Our history shows us that when we, in the navy, get thus far, rapid strides in efficiency are not far off.

To come down to details, I submit that it is apparent that inspection should continue as it now is (in principle) for all material for stock, all manufactured and raw material passed into stock, all work done on ships in commission, and all tests for completed machinery and mechanical devices.

Incidentally, let it be noted that the strictures of the essayist on the inspection of work by ships in commission, while undoubtedly well founded,

is not a prevalent condition. Most well-organized ships have a careful and complete system of inspectors and sub-inspectors organized as a permanent part of their ship's organization, with a very complete system of job-order cards, and daily checks as to the degree of completion of work, its character and the workmen employed. Theoretically the inspection officer should not have to worry greatly about ships in commission. His duties in that regard are limited to advice and assistance.

Such being the case, there remain for inspection the means, methods, work, organization, and cost at the different navy yards. Also the questions of survey and appraisal. These latter, while capable of economic improvement, are minor matters compared to those just before mentioned.

How then shall we improve—by inspection—these important means, methods, etc.? Under the present system the "commandant's eyes" are the inspection officer and his staff. Is this the best way or can a better be found? As already stated this system has turned the minds of all navy yard workers—from chiefs of divisions to laborers—into the channels that lead to improvement. This alone justifies its introduction.

This, however, having been done let us ask ourselves if it is a logical condition to subject experts, up to the point of direction in the details of their work, to the criticism of those less expert. I speak of the present, not of what has gone before.

This view (*i. e.* that it *is* logical) is what I understand the essayist to uphold. He advocates a young constructor being put on the inspection officer's staff to criticize the work and methods of the experienced hull division; a young pay officer being put on that staff to criticize the experienced G. S. K.; and young line officers (machinery, electrical, and ordnance) being placed there to criticize the work of those more experienced. And when I say criticize I do not mean merely comment upon, but by the consequences of the system, *direct*, through the commandant, the whole means, methods, organization, and system of navy yard work.

Outside of its military aspect, is this logical?

Why should not the hull and machinery divisions each have their own inspection department, based on the same system as that used on ships and elsewhere in the navy? That is to say, recognize that the head of a division is the most experienced expert in his branch at a navy yard, and that he is the one most eagerly interested in its efficiency as being the one most vitally concerned in its work.

Cap this with a more extensive board for shore inspections, making more detailed and extensive investigations of all general and local navy yard conditions, all with a view—the only view—of co-operation for betterment, and assistance to attain that end.

LIEUT.-COMMANDER W. T. CLUVERIUS, U. S. Navy.—I believe that Lieut.-Commander Parker has correctly expressed the intent and purpose of the naval regulations concerning the inspection of work. The indirect implication of his paper is the necessity of standardization in carrying on the inspection thus comprehended, and when this is achieved I cannot but feel that beneficial results will obtain and be generally appreciated.

The fleet is the thing. This has been realized, and also it is established that the base exists for the fleet. The reference, then, of all work performed at a navy yard is to the ship—a unit of the fleet. The ship must have what she needs in order to maintain maximum efficiency, and the yard must furnish it. The ship, therefore, must know what she needs and to insure this there is provided for her an inspection force of her own.

This force must deal directly with the yard. No matter how excellent the system of management concerned, or how great the desire to have work progress smoothly, friction to a greater or less degree will occur. It may be to the extent only of misunderstanding, or to that of decided objection. The function of the yard inspection force—made up of a personnel which knows what the ship needs, and why, and which also knows what the yard is doing and can do—is to adjust, by explanation, co-operation, or decision, the point at issue, that is, to lubricate.

The ship's inspection force must be a most potent element of any system of management, no matter how scientific or how casual, as long as the ship is the criterion. The yard inspection force, inspecting work directly or indirectly destined for the ship or the ship's welfare, must be the co-ordinator. A centralized, disinterested force of this nature, representing ship and shop, is more useful certainly than is the individual inspecting force of separate shops passing on the results of their own productive labor, with horizon limited as to the completion and application of the work as a finished whole, and of which each shop concerned does only a part. It has been criticized as an overhead in yard operations. It is. And it is a useless overhead if its personnel is inefficient, a defect as readily corrected as determined. It is useless if a single element of bias or favoritism exists, faults naturally more prone in a system in which self-inspection obtains. It is reasonable to expect impartial inspection by a disinterested force. In a commercial plant opposition is expected to arise spasmodically from those doing the work directed against the force which inspects, criticizes and turns down, if need be, the work of their hands, or which recommends any change the effect of which is not personally beneficial. In the naval service such a stand cannot be sanely based, for properly the good of the service and not personal gain is at heart, and the best there is in the yard of workmanship and endeavor is insured to the ship.

If, however, the inspection department succeeds in reducing any of the other numerous overheads always to be encountered in the varieties and class of work of navy yards—manufacture, repairs, and new construction—then the inspection overhead is positive in value and is a gain.

Lieut.-Commander Parker has covered the ground well. This point should be accented, that is, that the value of inspection at once begins to suffer diminution if it delays the progress of work. With a carefully selected and intelligently arranged force the inspection of the work in the majority of yard operations can be made coincident with the work. I refer particularly to the routine inspection covered by an inspection force that has to deal with the output of the purely manufacturing plant. In other words, the inspection notice can be signed when the job order is closed. A ship's inspection force can do this, and more, with less effort than the yard force, for its work is more concentrated and under easy surveillance.

The scope of the work is great and extends to numerous sorts of articles for stock or shipment in connection with the construction of new vessels, to work on vessels in ordinary or belonging to other branches of the service, and to work in connection with the military upkeep of the yard. Just as yard force must cover the entire field of inspection, so must the ship's force. While giving the yard credit for its desire to do good work, no chances can be taken that will allow inferior workmanship in any detail, through oversight or error, to become incorporated in a vessel of the fleet. In addition, time also is of vital consideration, being both a factor of economy and of military necessity.

I hold, then, in a word, that the goal of inspection is the expedition of properly performed work.

The essayist has dealt well with the subject of costs, the analysis of which the inspection department can and should make, and see that the manufacturing department gets the benefit.

To those who have seen inspection departments operating under different auspices, the need of standardization of their work is obvious. Some of those connected with inspection departments may believe that efforts at standardization will result in limitation of duties or authority. I do not believe that this can happen. Sound judgment will not place limitations on a field not yet fully explored. Just as concentrated effort is productive of the greatest good to the fleet, so concentrated effort will render the positive value of inspection a maximum.

Aviation in the Navy.

CAPTAIN W. I. CHAMBERS, U. S. Navy.—I am much pleased with Assistant Naval Constructor Hunsaker's translation of Lieutenant Lapointe's valuable article on Aviation in the Navy and I hope that more officers will be inspired to do similar work, as foreign technical publications are already rich in valuable aeronautical information of which there is no counterpart in this country.

I am specially impressed by the author's statement regarding aeroplane equilibrium in which he points out that the usual definition is inexact because "a static equilibrium is assumed in place of an actual dynamic equilibrium," that no account is usually taken of the forces of inertia which are "most important." I have endeavored to lay stress upon this feature in an article on hydro-aeroplane flying and to show that careful attention must be paid to it in maneuvering these "heavy load" machines with low centers of gravity.

His remarks about the horizontal rudder, or elevator, were evidently written before the latest improvements which almost invariably point to a rear non-lifting surface to which a rear elevator only is attached.

I agree with him as to the advantages of flexible wings and the possibilities of a satisfactory degree of inherent stability, or rather of inherent recovery of equilibrium, also as to the impossibility of gyroscopic regulators and, in general, as to "automatic stability" or more properly "automatic regulation of equilibrium." But the analogy of operating a sailboat automatically is hardly fair, since a better comparison would be with the auto-

matic control of a submarine or a torpedo, and no one will doubt that there would be advantage in having, at least, a semiautomatic control to assist in steadying the vertical longitudinal oscillations of a submarine while in the submerged condition.

His discussion of the question of monoplane *versus* biplane is altogether admirable, but in regard to the ornithopter I am inclined to think that the efficiency of the motive power necessary for flapping wings would not be as great in comparison with the screw power *in high winds*. It appears to me for this reason that it is only the large birds with soaring ability that are able to negotiate the high winds.

In regard to his statements about the mathematics of propeller design, I cannot express an authoritative opinion from a mathematician's standpoint, but I am sure that my experience thus far, with the theories and demonstrations in this line, bears ample testimony to the accuracy of his statements and it is evident that the only proper understanding can be arrived at from the results of actual experimental analysis at a properly equipped aerodynamic laboratory.

I endorse most emphatically the writer's condemnation of the acrobatic stunts of a certain class of aviators and I have reasons for believing in the probable advent of the internal combustion turbine as a relief from many existing motor difficulties, but I do not agree with the statement that variable speed is of no advantage to an aeroplane motor except for a few moments before landing. For I am greatly impressed by the belief that safety in flight can be practically assured by flying at a standard speed which is between the high and low critical limits and that it is necessary, for safety, to be able to increase or to reduce the speed in maneuvering.

I am quite sure that the majority of our naval officers will agree with this writer on the relative importance of "capital ships" and auxiliaries, and to me no demonstration is necessary to agree as to the future rôle of aeroplanes in the navy except, perhaps, in that of exercising the functions of fire-control. The latter I will admit, however, as soon as soaring flight is made practicable.

I must disagree entirely with the author's view of the hydro-aeroplane for the reason that if aeroplanes are to be of real service they must be kept in more or less constant use for instruction, training and maneuvers. We must be as familiar with them as we are with guns and boats. They must abide with us and we must have the means, therefore, of utilizing nature's best aerodrome, the water, whenever the circumstances permit. I do not intend to convey the impression, however, that the hydroplane attachment must of necessity be carried during long scouting flights. Furthermore, the use of a "garage vessel" would add another of the needless auxiliaries, which, according to his reasoning, should be avoided.

I am in accord with Lieutenant Lapointe in regard to the use of dirigibles, but am inclined to think it would be a mistake to limit the size to such an extent as to restrict their power to rise to an altitude sufficient to make them safe from gun fire. Great improvements in the strength of envelopes and their resistance to solar radiation are in progress, but much remains to be done to perfect a dirigible suitable for naval purposes.

The author's statement regarding the value of an aerodynamic institute or laboratory cannot be overestimated. Such an establishment is of pressing importance and I am very glad to say that such laboratory work in connection with hydroplane models is already progressing satisfactorily at the Naval Model Basin.

Absence Over Leave in the Fleet.

(SEE No. 140.)

CAPTAIN HUGH RODMAN, U. S. Navy.—A letter to the Department:

U. S. S. *Cleveland*, Cavite, P. I., May 26, 1910.

SIR: 1. Upon taking command of this vessel about a year ago, I found her to be efficient and clean, and that she had been designated by the Commander-in-Chief as a "Smart Ship"; her crew was happy and contented, and it seemed hard to improve upon the discipline on board.

2. Throughout my command, there have been but few serious offenses, most of the reports being due to rum and liberty breaking, and were made in the first few months after I joined; so steps were taken to put an end to these offenses as far as practicable, and with some degree of success.

3. With this end in view, the crew was informed that every opportunity would be taken to grant first class men as much liberty as possible, but that those who showed themselves to be rum-soaks and liberty-breakers would be punished to the full extent of the law. After this plan had been carried out for a few months, a number of the worst offenders were called to the mast in a body, both courses which they might take were fully explained to them, and without exacting any pledges or promises, they were asked to choose the one which they preferred to follow; namely, to continue to violate the regulations and to take the consequences, or to turn over a new leaf and receive the benefits thereof.

4. It was explained that if they chose the latter, they would be given a chance, and would be put on probation until they had a fair trial; that furthermore, they would understand that not only was each individual to behave, but he would use his influence to induce others to do so; that offenses coming under their observation were not to be reported, but that the offenders were to be induced, if possible, to mend their ways, and if they found men under the influence of liquor ashore, that they were to be kept from drinking more, or if inclined to overstay liberty, that they would use every effort to induce them to return to the ship on time. No wholesale immunity was granted; from time to time, other offenders requested permission to go on probation; the officers and petty officers coöperated, and in fact the whole crew have, and the plan has succeeded admirably.

5. My promise has been made good, there is practically a free gangway to special first class men, so far as the regulations allow, and not only is no opportunity neglected to give liberty, but the men are encouraged to go as often as possible.

6. Out of all who were put on probation, there have been but two backsliders, and many of the worst offenders have become special first class; and, in my opinion, the result has been largely accomplished by treating the men

as men, by talking to them firmly but kindly, by analyzing each individual case, punishing when necessary, and by encouragement where it would seem best, and by putting the men on their metal, honor, and pride, and by recognizing these qualities in them, when they have made good.

7. When a punishment is awarded, it is well as far as practicable, to have a uniform standard of punishments for offenses, but it is a mistake to punish for every offense, and a greater one to treat all men alike; many a man has kept his enlistment record clear by being admonished, warned, or put on probation, and by explaining to him the advisability of behaving himself. Some are best approached by kindness, others need a few severe punishments to bring them to their senses; under ordinary circumstances I believe the best results are obtained by trying to analyze each individual character, and if there be any doubt whatever about the best course to pursue, to then think the matter over for twenty-four hours before acting. Above all, avoid hasty conclusions, and be sure that no innocent man is punished. Men who have clear records should be given more consideration than those who continually violate the regulations; many a good man commits a serious offense in a fit of anger, and while still angry, is inclined to be stubborn and obstreperous, who, if given time to cool down and think over the error of his ways, may make amends by apologies and profit by any leniency that may be shown him.

8. Again I believe much discontent amongst the crew is caused by punishing the whole crew for the offenses of a few; for instance, if certain members of the crew get drunk and create a disturbance on shore, and it is impossible to apprehend the guilty parties, I believe it to be a most serious mistake to stop the liberty of the whole ship's company, on this account, or until the guilty parties are apprehended.

9. Petty punishments, for trivial offenses, which are so often awarded, and poorly carried out, have been generally avoided; serious offenses deserving punishments have been awarded severe ones rather than otherwise, and these have been carried out to the letter.

10. A commanding officer cannot be too careful in sizing up the officers under him, in their dealings with the crew, and in noting and correcting individual characteristics which nag and humiliate the men. We have all noted that some officers are liked, some disliked, that some make a great number of reports, others very few, that some perform their duty smoothly, and without trouble, while others seem to meet numerous stumbling-blocks; all of this should be noted and duly weighed by the commanding officer, and steps be taken to immediately correct when necessary, and to point out to the officers concerned the proper course to pursue. Firmness and perfect fairness, seasoned with some of the milk of human kindness, will greatly leaven discipline, and serve to make a happy ship.

11. No opportunity has been lost to add to the comfort of the crew; at stated times committees regularly appointed can make requests and suggestions, in regard to the general mess, or matters relating to the pleasures or comforts of the crew.

12. Every effort has been made to encourage the men to take a pride in the ship, and to make it as much of a home for themselves as possible, and

I believe that she is not only a happy ship, but that the discipline compares favorably with that of any other in the service.

13. In conclusion, it can be stated positively, that offenses that deserved punishments have not been condoned; had this been the case the result would have been far different. There have been no cases of rum or drunkenness on board ship for six months, and the only signs of it have been seen in a few men returning from liberty; liberty-breaking has practically stopped, and it is considerably less than 1% of those who go on leave; to-day 92% of the men are special first class, 2% first class, and only 6% are classed, and these are mostly men who have recently been transferred from other vessels.

The True Story of the America.

(SEE No. 126.)

MR. WILLIAM BARRY MEANY, M. D.—The Continental Ship *America*.—My attention was recently called to an article which appeared in Vol. 34, No. 126, June, 1908, of the United States Naval Institute Proceedings, under caption, "The True Story of the *America*," by Robert W. Neeser.

The leading or key-note paragraph (first paragraph, p. 574) of the article, pp. 573 to 580, both inclusive—and wherein no mention of, or any reference to, the name of Commodore John Barry appears—reads:

"No mention of the *America* * is again made in official documents until June 23, 1779, when Congress authorized Robert Morris to take measures for the speedily launching and equipping for sea the *America*, then on the stocks at Portsmouth, N. H., and three days later, by unanimous resolution, appointed John Paul Jones to command her."

If Mr. Neeser's dates of June 23, 1779, and his "three days later" (June 26, 1779) be corrected to read June 23, 1781, and June 26, 1781, respectively, they would only further accentuate the mistake.

The following letters are copies made by the writer from the official documents of the Continental Marine Committee, on file in the manuscript rooms of the Library of Congress, Washington, D. C.

"Nov. 6, 1779.

"Captain John Barry.

"SIR: As you have been appointed to command a new continental ship (the *America*) that is now on the stocks at Portsmouth in New Hampshire, you are hereby directed to repair to that place and hasten as much as may be in your power the completing of that ship, which we are desirous to have done with all possible despatch. We have now communicated our desire on that head to the Honorable, the Navy Board at Boston, whom you will please to call on in your way and receive such orders as they may think proper to give you.

"Should Mr. Langdon and you agree that any alteration can be made in this ship that will render her more suitable than the present design, you will please to communicate your plan and a state of the ship, which we will consider."

* From about Nov. 9, 1776. See page 573.—W. B. M.

"Nov. 20, 1779.

"Captain John Barry.

"SIR: Agreeable to your desire, we have appointed Captain George Jerry Osborne to command the marines on board your ship, but as it will be a considerable time before there is occasion to raise his men, we have been so early in his appointment on the principle of his being useful in doing matters relative to the ship (the *America*) until that time, you will please to observe and employ him occasionally in such business as you may think proper."

Joseph Dennie (editor of the *Portfolio*), in his biographical sketch of John Barry as it appeared in the *Portfolio* (Philadelphia), July 13, 1813, wrote:

"Having made several voyages to the West Indies in letters of marque vessels, he (Barry) was afterward ordered to take command of a 74 gun ship building in New Hampshire."

It is in order here to state that, owing to the lack of funds to carry on the construction and to complete this new ship of 74 guns, with the considerable time required for its construction, Captain Barry was appointed to take command of the *Alliance*, and to prepare her for a voyage, to carry our envoys, Colonel Laurens and suite, on an important embassy to the French court. When this new ship of 74 guns (the *America*) was completed, at a much later period, about Nov. 5, 1782, Congress had concluded to present her to the King of France.

Barry safely landed his passengers on the *Alliance* in France, and Colonel Laurens succeeded in securing six million livres (gold) from the French King. For details of this voyage etc., see pp. 23, 46, 47, 57 and 62, of my book, "Commodore John Barry"—Meany (Harpers).

In the Journals of Congress (on file at the Library of Congress, Washington, D. C.), June 23, 1781, page 135, the following appears:

"A committee consisting of Mr. Clymer, Mr. Sullivan, Mr. Mathews, to whom were referred two letters of 22d, from Robert Morris, delivered in a report; whereupon: Resolved, That Robert Morris, esquire, be, and is hereby, authorized and directed to take measures for the speedily launching and equipping for sea the ship *America*, now on the stocks at Portsmouth, New Hampshire; That the board of Admiralty be, and they are hereby, directed to assign Mr. Robert Morris the proceeds of the share of the United States in the prizes taken by Captain Barry, to enable Mr. Morris to carry into execution the preceding resolution; That Congress proceed on Tuesday next to the appointment of a commander to the said ship *America*."

On Tuesday June 26, 1781, page 135, appears: "Congress proceeded to the appointment of a captain to the command of the ship *America;* and the ballots being taken, John Paul Jones, esquire, was unanimously elected."

In the Journals of Congress, Sept. 3, 1782: "On motion of Mr. Osgood and seconded by Mr. Williamson—Whereas, the *Magnifique*, a seventy-four gun ship, belonging to the fleet of His Most Christian Majesty, commanded by the Marquis de Vandreuil, has been lately lost by accident in the harbour of Boston, Congress are desirous of testifying on this occasion to his

Majesty, the sense they entertain of his generous exertions on behalf of the United States: Resolved, that the agent of marine be and is hereby instructed to present the *America*, a seventy-four gun ship, in the name of the United States, to Chevalier de la Luzerne for the services of His Most Christian Majesty."

On or about Nov. 5, 1782, the *America* was safely launched under the supervision of the gallant John Paul Jones—who from June 26, 1781 (or shortly afterward), had charge of her construction and completion.

A few days after the *America* was floated she was turned over to the French Admiral, and when fully equipped for sea, she sailed for France.

It is stated that, after two or three years in the French service, she was condemned; her timbers were found to have rotted, owing, it is said, to the unsuitable or to the unseasoned wood used in her construction.

PROFESSIONAL NOTES.

Prepared by LIEUT.-COMMANDER RALPH EARLE, U. S. Navy.

SHIPS OF WAR, BUDGETS AND PERSONNEL.

ARGENTINE REPUBLIC.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Rivadavia	28,000	Fore River Shipbl'dg Co.	Launched Aug. 26, 1911.
Moreno	28,000	New York "	" Sept. 23, 1911.

The Argentine Republic Minister of Public Works has signed a contract for the construction of a drydock at Puerto Belgrano capable of holding the large battleships now being constructed in the United States for government of Argentina. The cost will reach $6,369,000, and the work is to be completed in three and one-half years, meeting the rapidly increasing demands for docking facilities for naval and mercantile vessels.—*International Marine Engineering.*

AUSTRIA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Radetsky	14,500	Trieste.	Under trial.
Zrinyi	14,500	"	Launched April 12, 1910.
Erzherzog Franz Ferdinand.	14,500	"	Under trial.
Viribus Unitis	20,000	"	Launched June 24, 1911.
Tegetthof	20,000	"	Launched March 21, 1912.
VI	20,000	"	Authorized.
VII	20,000	Fiume.	"

THE "TEGETTHOFF."—This vessel is of 20,040 tons displacement, 525 to 495 feet long (authorities differ within these limits), 89 feet beam, having a draft of 26 feet. Her main armor belt is 15 feet wide and 11 inches in thickness at the central part on water-line, tapering to 8 inches above and to 4 inches at ends. The barbettes and gun hoods are of 11-inch armor. The armament is twelve 12-inch guns mounted in four triple gun turrets, the guns of No. 2 and No. 3 turrets firing over the guns of Nos. 1 and 4 respectively. There are twenty-four 4-inch guns mounted in a central battery behind armor. There are four submerged torpedo-tubes. Horsepower is 50,000, to give a speed of 23 knots. Parsons' turbines and Yarrow boilers are fitted. Bullivant torpedo-nets are provided.

The old casemate ship, the *Tegetthoff*, was renamed the *Mars*.

SCOUTS.—The three scouts of the building program are of the *Admiral Spaun* class improved, with engines of 25,000 horse-power as compared with 21,000, and designed speed at 27 knots. They will mount nine 4.7-inch guns and two smaller. The six destroyers, which are also to be built at Fiume, are to be 800-ton vessels, with engines of 17,000 horse-power, and estimated speed of 32.5 knots. The twelve sea-going torpedo-boats are to travel at 28 knots.—*Army and Navy Gazette.*

PROGRESS IN 1911.—The wrecking steamer *Hercules* was completed as was also a special ship for submarines. A floating dock with a capacity for 22,500 tons was completed.

The navy is devoting attention to aviation and a military-naval aviation station has been established at Pola. Owing to the war between Italy and Turkey the Austrian fleet was kept fully manned during latter part of 1911. —*Marine Rundschau.*

SUBMARINES.—The submarines are of Lake type and will be furnished with benzol motors, and this fuel will be superseded by petrol in future submarines.

FLOATING CRANE.—A floating crane provided with long arm to serve for raising submarines is being built at Pola for the Austrian Navy. This crane is fitted to grapple a submarine at a depth of 50 meters, and raise the boat until her conning-tower is above water or one of its ends are on the surface.—*Marine Rundschau.*

PERSONNEL CHANGES.—The Austrian Navy contemplates introducing a new rank between that of Korvettencapitan (lieutenant-commander), and Linienschiffscapitan (lieutenant), and the new rank will be Kapitanleutnant which corresponds in title and grade with the same rank in German Navy and is the same as U. S. naval rank of lieutenant, but hitherto the Austrian rank of battleship-lieutenant was regarded as equal to the rank of Kapitanleutnant (lieutenant U. S. Navy).—*Marine Rundschau.*

BRAZIL.

M. Geraes	(2)	19,250	23,500 = 21	12 12-inch, 50 cal.	8,500
				22 4.7 inch.	
Rio de Janiero.....	(1)	28,000	= 22	14 12-inch, 50 cal.	11,900
				20 6-inch, 12 12 pr.	

CHILI.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Constitucion.....	27,500	Elswick.	Laid down Nov. 1911.
Libertad	27,500	Vickers.	" " Dec. 1911.

BATTLESHIPS.—These are to be 625 feet long, to carry 3500 tons of coal and 450 tons of oil fuel.

The new Chilian naval engineering school at Talcahuano is to be completed in time for the opening of the school year in March of this year. It will be equipped for 200 cadets, but only 150 are to be admitted for the present.—*Shipping*, Illustrated.

FRANCE.

VESSELS BUILDING.

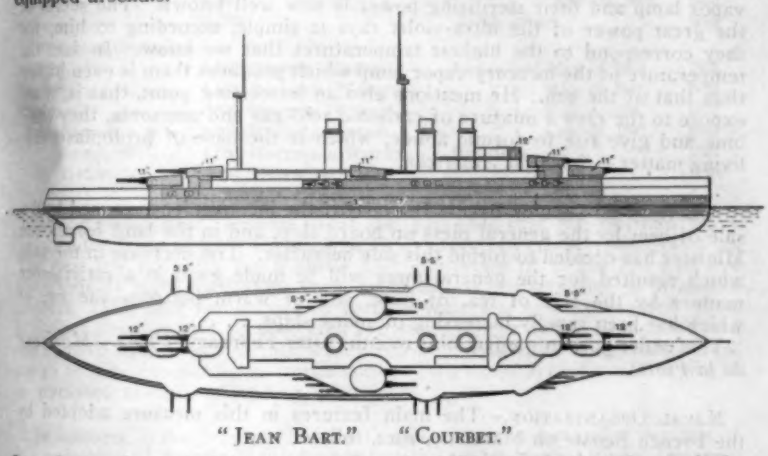
Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Courbet	23,500	Lorient.	Launched Sept. 23, 1911.
Jean Bart	23,500	Brest	" Sept. 22, 1911.
France	23,500	St. Nazaire.	Building.
Paris	23,500	La Seyne.	"
Bretagne.....	25,000	Brest.	Authorized.
Provence	25,000	Lorient.	"
Lorraine	25,000	A private firm.	"

THE 1912 PROGRAM.—This contains three battleships—instead of two as predicted, one replacing the *Liberté*—to be placed on stocks this year; and

includes the building of ten other battleships spread over five years. One of these battleships, the *Lorraine*, will be built in a private ship yard, and if this experiment is successful other vessels will be built by private yards. The law provides that in January, 1920, there will be finished 28 battleships, 10 scout cruisers, 52 destroyers, 10 foreign service ships, 95 submarines, 4 mining vessels, and various auxiliaries. Battleships are to be laid down as follows: three in 1912, two in 1913, two in 1914, four in 1915, and two in 1917.

The expenditure authorized is $281,000,000 during eight years for new constructions.

DOCKS.—The French naval program in the matter of docks provides for the present deficiency, as no less than $24,000,000 are, during the next eight years, to be devoted to the construction of twelve docks, capable of receiving 24,000-ton ships. These docks—six in the North and six in the South—will confer important strategic advantages on the French battle fleet, enabling it to transfer its activity from the Mediterranean to the Atlantic and Channel with the certainty to have near at hand adequately equipped arsenals.



"JEAN BART." "COURBET."

Length, 541 feet; 23,096 tons; speed, 20 knots; armament, twelve 12-inch, twenty-two 5.5-inch.

—From *Brassey's Annual.*

The Lorient dock will be difficult of access, and that of Cherbourg will be exposed to bombardment from the high sea, but this reproach cannot be applied to the Brest, Toulon and Bizerta arsenals.—*The Naval and Military Record.*

COMMENT ON PROGRAM.—We have questioned the expediency of this expenditure, but many have criticised the program, because it provides almost exclusively for battleships of the *Dreadnought* class, instead of following the lead of England in the construction of battleship-cruisers. M. Delcassé pointed out that the policy of France was to concentrate her forces in the Mediterranean. Consequently she required powerful units in which speed was not a primary consideration. Flying machines were expected, in a certain measure, to replace scouts and cruisers, and in a closed sea like the Mediterranean heavily armored battleships had a great advantage. Having fallen from the second to the fourth position amongst naval powers, France is determined not to drop farther in the rear. Since M. Delcassé took office a great change has certainly come over the French Navy.—*The Engineer.*

QUADRUPLE TURRET?—The four-gun turret may make its first appearance in the French battleships of 1913. There are three schemes under consideration. One provides sixteen 12-inch in four turrets; the second for twelve 13.4-inch in three turrets; the third for the same in four turrets, two double and two quadruple turrets.—*United Service Magazine.*

BATTLESHIPS.—*Bretagne, Provence,* and *Lorraine* will be 23,500 tons displacement, 541 feet long and 88.56 feet beam. The armament will consist of ten 13.3-inch guns in five turrets in the longitudinal axis of the ship, twenty-four 6-inch guns, and four torpedo-tubes. The speed will be 20 knots with 28,000 horse-power. The complement will be 1000 men.—*Marine Rundschau.*

ULTRA-VIOLET RAYS IN SUBMARINES.—At a recent meeting of the Comparative Pathology Society at Paris, M. Daniel Berthelot brought out the fact that ultra-violet rays could be used for purifying the air in submarine boats. Such rays are produced in great quantities by the quartz mercury vapor lamp and their sterilizing power is now well known. The secret of the great power of the ultra-violet rays is simple, according to him, for they correspond to the highest temperatures that we know. In fact the temperature of the mercury vapor lamp which produces them is even higher than that of the sun. He mentions also an interesting point, that is, if we expose to the rays a mixture of carbonic acid gas and ammonia, they combine and give rise to formic amide, which is the base of protoplasm and living matter.—*Scientific American.*

ABOLITION OF SALE OF BEER.—Because of the inconvenience caused by the sale of beer by the general mess on board ship, and in the land forces, the Minister has decided to forbid this sale hereafter. The decrease in the gain which resulted for the general mess will be made good in a satisfactory manner by the sale of tea, of milk, and of warm boissons the use of which has been rapidly increasing on many ships. . . .

This order goes into effect nine months after February 5, 1912.—*Moniteur de la Flotte.*

NAVAL ORGANIZATION.—The main features in this measure adopted by the French Senate on March 29, 1912, follow:

The fleet has four divisions:

1. The battle fleet, composed of 28 battleships, 10 scouts, 52 sea-going destroyers.
2. The foreign service fleet, as exigences require.
3. Submarine defence fleet. Ninety-four submarines, four mine-carrying and laying vessels, mine sweepers, and torpedo vessels as required.
4. Special service vessels. Three surveying ships, three transports, schoolships and coast-guard vessels.

Battleships built prior to 1906 will be scrapped when 25 years old, those built later when 20 years old; the destroyers and submarines when 17 years old. Vessels to replace these will be built so as to be ready when these are retired. Vessels lost by wreck will be replaced by vessels started as soon as possible thereafter.

The preparedness of divisions follows:

1st division. One-half will be always in full commission.
2d division. All will be ready for service.
3d division. One-half kept ready.
4th division. Will be fixed by Navy Department according to needs.—*Moniteur de la Flotte.*

GERMANY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.	Completion due.
Battleships.				
Oldenburg	22,400	Danzig (Schichau).	Undergoing trials.	1912
Kaiser	24,500	Kiel (Kaiserliche W.).	Launched Mar. 22, 1911.	1912
Friedrich der Grosse	24,500	Hamburg (Vulkan).	" June 10, 1911.	1912
Kaiserin	24,500	Kiel (Howaldt).	" Nov. 11, 1911.	1913
König Albert	24,500	Danzig (Schichau).	" April 27, 1912.	1913
Prince Regent Luitpold	——	Germania Works.	" Feb. 21, 1912	1913
Ersatz K. Friedrich Wilhelm	——	Hamburg (Vulkan).	Building.	1914
" Weissenburg	——	Bremen (Weser).	"	1914
" S	——	Wilhelmshaven.	"	1914
Armored Cruisers.				
Goeben	22,600	H'b'rg (Blohm and Voss).	Launched Mar. 28, 1911.	1912
Seydlitz	25,000	"	" Mar. 30, 1912.	1913
K	25,000	"	Authorized.	1914
Protected Cruisers.				
Breslau	4,500	Stettin (Vulkan).	Launched May 16, 1911.	1912
Magdeburg	4,500	Bremen (Weser).	" May 13, 1911.	1912
Stralsund	4,500	Bremen (Weser).	" Nov. 4, 1911.	1912
Ersatz Strassburg	4,500	Wilhelmshaven.	" Aug. 24, 1911.	1912
" Seeadler	4,500	Germania Works.	Building.	1913
" Geier	4,500	Howaldt.	"	1913

The proposed new German naval law proposes that the German Navy be extended from 58 to 61 big ships, with 40 protected cruisers instead of 38. The new law provides for a battle fleet consisting of a flagship and five squadrons of eight battleships each, 10 first-class cruisers and 30 protected cruisers. The fleet for service in foreign waters is to be composed of 10 first-class cruisers and 10 protected cruisers. Three active squadrons and one reserve squadron, together with a flagship, making in all 33 battleships, are to be kept constantly in commission. Two extra armed cruisers are to be stationed abroad.—*Shipping*, Illustrated.

An increase in the personnel of the German Navy is demanded because of the necessity of having a third squadron in active service since delays in getting the reserves into action would leave the naval strength below requirements.

The increase in the navy personnel of German Navy up to 1920 requires an annual increase of 75 officers including engineers, surgeons and paymasters and 1600 men. This increase in the personnel requires additional expense each year: 1912, about $3,750,000; 1913, about $7,000,000; 1914, about $9,500,000. Reaching maximum annually in 1916 about $11,750,000.—*Marine Rundschau.*

THE "KAISER" CLASS.—Dimensions are: length, 564.3 feet; breadth, 95.15 feet; draft, 27.2 feet; displacement, 24,500 tons; speed to be 21 knots with 25,000 horse-power. They are turbine driven and the first of Germany's big ships to be so.

Armament is ten 12-inch and fourteen 6-inch.

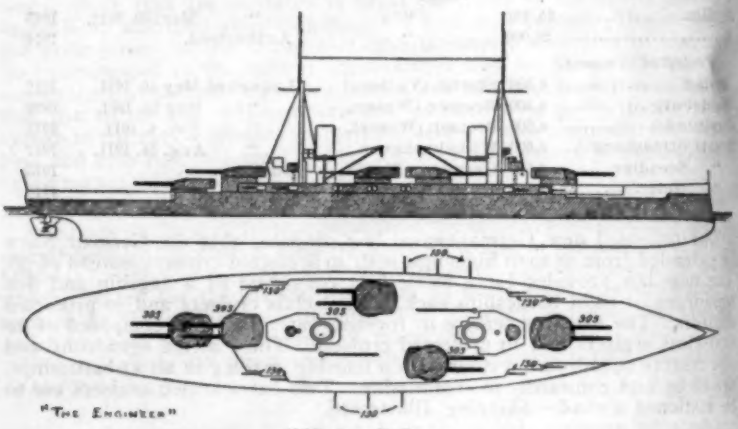
The *Prince Regent Luitpold* will be the first to be armed with 14-inch guns.

The ballistics of the German 12-inch gun, forming the main battery of the *Kaiser* class are said to be superior to those of the corresponding weapon, Mark XI and XII. The life of the new gun is 20 per cent to 25 per cent shorter than that of the 28 cm.—11-inch—gun of the *Nassaus*, and has been

estimated at a maximum of ninety rounds fired without altering the ballistic properties. The weight of each gun position, including armor protection of the turret, is about 550 tons, so that the weight of the main battery amounts to 2750 tons. The weight of the projectile is given at 390 kilos uncapped and 434 kilos with cap. It does not therefore differ much from the weight of the English shell of equal caliber, and is somewhat lighter than the corresponding French projectile.

If strikes do not delay their completion the *Kaiser* and *Friedrich der Grosse* will be ready for trials in the course of this summer, thus slightly reducing the average time of construction of the previous ships.—*Engineer.*

The German battle-cruiser *J*, laid down in 1910, was launched at Hamburg Saturday, March 30, from the yard of Blohm & Voss, and christened the *Seydlitz*. The *Seydlitz* is the fourth vessel of her class in the German Navy. Her length is said to be 558 feet, beam 87 feet, draft 26 feet, and displacement 23,000 tons. Her engines indicate 70,000 horse-power and the agenda speed is 28 knots.—*Shipping*, Illustrated.



"KAISER" CLASS.

"MOLTKE."—The corrected official speed of this vessel is given as 28.4 knots.

NEW SUBMARINE FLOTILLAS.—According to reports from Kiel, a second submarine flotilla will be ready for service next autumn, giving a total of twenty-four such vessels for the German Navy. As at least another flotilla is under construction, and a fourth projected, it is evident that Germany is now determined to make up for lost time, and to equip herself with a numerous fleet of these under-water torpedo craft. In the course of this year the submarine detachment will number 516 men, exclusive of officers, this figure comprising 182 seamen and 334 machinists. The training these men undergo is particularly careful and practical. At the submarine school through which each man passes before he is allowed to serve in the flotilla there is a full-size model of the interior of a submarine, with every engine and appliance in place just as in the boat itself. By this means the men become perfectly familiar with their duties, and may be said to have a good working knowledge of a modern submarine before ever they step on board. Special attention is given to the use of rescue appliances, the men being instructed as to their duty in every possible contingency. In the flotilla itself realistic experiments in the locating and raising of a sunken submarine are

constantly practised with the aid of the parent ship *Vulkan*. When a detachment of boats is permanently stationed at Wilhelmshaven or Cuxhaven, which will be when the second flotilla is ready, it is proposed to institute longer and more arduous cruises than have yet been undertaken for the purpose of accustoming the crews to deep-sea operations under conditions closely resembling those of war. The future distribution of submarines when four flotillas are available will probably be as follows: Two flotillas at North Sea ports, one at Kiel, and one in reserve, but ready at a few hours' notice to reinforce either the Baltic or the North Sea flotillas.—*Naval and Military Record.*

SUBMARINE MANEUVERS.—The maneuvers of these vessels are generally kept a close secret, but we learn that the Kiel flotilla in a thick fog made a cruise from Kiel to Cuxhaven where they arrived in fine shape. The results of this first maneuver of the whole flotilla have been extremely satisfactory according to all reports. The German Navy, which waited such a long time before entering into the construction of submarines, appears now to be very sure of the worth of those she possesses. These, thought in the beginning as arms for defence solely, have now become powerful factors in the offence. The building of those now under way is being pushed so actively that, in the spring of 1912, a second flotilla will be ready for its trials. This flotilla will be attached to the North Sea fleet, its station is not yet fixed.—*La Vie Maritime.*

GERMAN COALING ACHIEVEMENT.—The Berlin correspondent of *The Times* states that the Emperor William has addressed to the commander of the battleship *Helgoland* a Cabinet order which he commands to be read on parade, and then to be framed and glazed, congratulating the commander and the crew on a recent coaling achievement. On February 9 the *Helgoland* took on board 1100 tons of coal in two hours, and achieved a maximum of 671 tons, and an average of 550 tons in the hour. The previous "record" was held by the battleship *Posen*, which took on board 900 tons of coal in one hour 45 minutes, and achieved a maximum of 642 tons, and an average of 514.29 tons in the hour on July 1, 1911.—*Naval and Military Record.*

In March the *Posen* took an average of 602 tons per hour, with 676 as a maximum, and the *Ostfriesland* took an average of 574 tons, with 722 as a maximum.

SOME NAVAL ACCIDENTS.—January 17, 1911. Submarine *U-3* sank in harbor of Kiel, two officers and one man drowned. The *Vulcan* was in dock at the time and reached the scene 12 hours late.

March, 1911. During gunnery practice, the destroyer *D22* received a shell in her stern. No fatalities. A cask of gasolene exploded on board the battleship-cruiser *Yorck*, killing three and wounding two.

April, 1911. The torpedo-boat *S-121* collided with the steamer *Hecla* and was injured so badly that she was out of service for over a month. Two destroyers collided, both suffering great injuries.

August, 1911. During practice at a target, towed by a destroyer, the target was struck by a shell, capsized, and dragged down three men with her. Grave defects were found in the steam piping of the new battleship *Thüringen*, which had to be towed to shipyard for long repairs.

September, 1911. The battleship *Hessen* rammed the Swedish steamer *Akersund* and sunk her.

October, 1911. The same battleship was rammed by the Danish steamer *Argo* and injured badly.

The small cruiser *München* sank a launch carrying sailors, drowning seven.

November, 1911. A 6-inch charge exploded on board the battleship *Thüringen*; five men seriously wounded.

A torpedo-boat *S-167* was rammed by a Dutch tug and injured seriously.

March 25, 1912. The German battleship *Elsass* collided with and sank the Swedish coasting steamer *Pollux* in the Skagerda between Norway and Jutland March 23. The crew of the *Pollux* was rescued.

GREAT BRITAIN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Conqueror	22,500	Beardmore.	Launched May 1, 1911.
Thunderer	22,500	London (Thames Iron Works).	Under trial.
Ajax	23,500	Scotts (Greenock).	Launched March 21, 1912.
Audacious	23,500	Cammell, Laird & Co.	Building.
Centurion	23,500	Devonport.	Launched Nov. 18, 1911.
King George V	23,500	Portsmouth.	" Oct. 9, 1911.
Centurion	25,000	"	Building.
Queen Mary	28,850	Devonport.	Launched March 29, 1912.
Benbow	.....	Beardmore.	Ordered.
Delhi	.....	Vickers.	"
Iron Duke	.....	Portsmouth.	"
Marlborough	.....	Devonport.	"
Armored Cruisers.			
Princess Royal	26,350	Vickers.	Launched Apr. 29, 1911.
Australia	18,800	Brown & Co.	" Oct. 26, 1911.
New Zealand	18,800	Fairfield.	" July 1, 1911.
Queen Mary	26,850	Palmer (Jarrow).	Launched March 20, 1912.
Tiger	28,000	Brown & Co.	Building.
Cruisers.			
Amphion	3,400	Pembroke.	Launched Dec. 4, 1911.
Southampton	5,400	Brown & Co.	Building.
Dublin	5,400	Beardmore.	Launched April 30, 1912.
Sydney	5,400	London & Glasgow Co.	Building.
Chatham	5,400	Chatham.	Launched Nov. 9, 1911.
Melbourne	5,400	Cammell, Laird & Co.	Building.
1	5,700	.....	.....
2	5,700	.....	.....
3	5,700	.....	.....

THE NAVY ESTIMATES.—The navy estimates provide for an expenditure during the year ending with March, 1913, of $213,814,190, and for the laying down of four large armored ships, eight light armored cruisers, twenty destroyers, together with a number of submarines and subsidiary craft. In the case of the four large armored ships to be laid down comparatively little progress will be made. They will not be commenced until an advanced date in the year, so that the expenditure on them in the year's estimates will be small. Twenty destroyers are to be commenced at once.

A special feature of the new program is the eight "light armored cruisers." This, we understand, is to be an entirely new class. The first desideratum in the new vessels will be speed, in order that they may serve as "eyes" to squadrons of battle-cruisers capable of maintaining a fleet speed of 28 knots. Obviously the new vessels must live in the same heavy seas and excel this speed. They will be armored so as to be indifferent to attack by destroyers; in other words, to live through such contact as requires the piercing of the fringe of the screen of an enemy's fleet, in order to ascertain the strength of the screen itself. The armament will be a tertiary consideration, as their firing will be purely defensive, and confined to such actions as are necessary to get and deliver information to the heavier fighting ships of their fleet.

The twenty destroyers will be ordered before March is ended, and the submarines later in the year. Among the new auxiliaries provided for are several vessels for conveying oil fuel to the fleet; throughout the estimates there are various suggestions of the extension of the use of this fuel. Thus on oil storage $630,500 is being spent at Chatham, $37,345 at Haulbowline, $121,250 at Hong Kong, $582,000 at the Humber, $213,400 at Invergordon on the Cromarty Firth, $64,505 at Pembroke, $121,500 at Portland, and $222,500 at Portsmouth; in some cases, as in the last two cases, the works in progress are in addition to existing provision. In all these cases substantial contributions are made under the estimates for progress with this work during the next year.

The total for new ship construction is $68,041,536.—*Engineering.*

On April 1, 1912, there are under construction: 10 battleships, 6 battle-cruisers (including one each for the Commonwealth of Australia and the Dominion of New Zealand), 8 second-class protected cruisers (including 2 for the Commonwealth of Australia), 2 unarmored cruisers, 31 torpedo-boat destroyers, 15 submarines (including 2 for the Commonwealth of Australia), 2 river gunboats.—*The Engineer.*

DRY DOCKS.—The docking accommodation available for the fleet, actual and prospective, is not unsatisfactory. Indeed, I may say I was very agreeably surprised by an inquiry I undertook into it. We possess at the present time nine docks which can take *Invincibles, Lord Nelsons*, and all earlier ships; and five of these are suitable for our latest battleships. In a few months there will be two floating docks capable of taking the largest size of ships which exist at present, and these two floating docks will be put, one in the Medway and the other ultimately at Portsmouth. Early next year there will be a new dock ready at Portsmouth, another also of the largest size will be ready in January, 1914. In 1916 the three docks and the lock at Rosyth—four in all—will be available. Meanwhile, there are five private docks we have in view to dock the largest vessel, and two others now in course of construction. In addition to the above, there are four others which will take in vessels of the *Invincible* class. That is, in the opinion of the Admiralty, sufficient provision for our needs at the present time. It is suggested that pending the completion of the docks at Rosyth, one of our floating docks when ready should be towed to Cromarty and used there as a subsidiary base with floating workshops. Further provision for docks will be necessary in 1916 or before 1920, for we have to look four years ahead in regard to docks. But there is no cause for anxiety or complaint in the immediate future.—*The Engineer.*

THE "AJAX."—Length, 555 feet; beam, 89.5 feet; draft, 27.5 feet. She carries ten 13.5-inch guns, sixteen 4.7-inch, and has three submarine tubes. The main battery is located in five turrets on the center line. The armored deck is 2.8 inches, and the belt is 12.2 inches, extending for two-thirds of her length. The two lower strakes are 12 inches, the one above that is 9 inches, and above that is 8 inches. Forward and aft of this tapering armor extends to bow and stern. Has Parsons' turbines fitted to run four screws. Trial speed to be 21 knots with 31,000 horse-power.—*Moniteur de la Flotte* and *Naval and Military Record.*

The *Queen Mary* is a sister ship of the *Lion*, described on page 321 of No. 141. She is expected to develop 75,000 horse-power and 30 knots speed.

The battle-cruiser *Tiger*, to be laid down this year, is designed for 87,000 horse-power, 30 knots speed, and will be 700 feet long and 90 feet beam.

STEAM TRIALS OF H. M. S. "THUNDERER."—The battleship *Thunderer* has successfully passed all her steam trials, and will return to the Thames to be completed for commission. This vessel was built by the Thames Iron

Works & Shipbuilding Co., the first keel-plate having been laid on April 13, 1910, and the vessel launched on February 1, 1911. The date for completion is May next. The *Thunderer* is a battleship with a displacement tonnage of 22,500 tons, the length being 545 feet and the beam 88½ feet. She is armed with ten 13.5-inch and twenty-four 4-inch guns, the gun positions being protected by 10-inch armor. The main broadside belt is 12 inches thick, tapering forward and aft to 4 inches, while the upper part on the broadside is protected with 9-inch armor. The boilers are of the Babcock and Wilcox type, and the turbines of the Parsons' design.

The first official trial consisted of a thirty hours run at about 70 per cent of the full designed power. During part of the time, as is usual with such ships, the engines worked with open and closed exhaust, separate results being taken in connection with the design of machinery for future ships. The mean result of the thirty hours run was that the machinery developed 18,927 shaft horse-power, while the average revolutions were 265 per minute. Six runs were made on the measured mile at Polperro, when, with a mean of 17,787 shaft horse-power, a speed of 18.8 knots was realized.

Throughout the eight hours trial at full power the engines ran at an average of 299 revolutions per minute, the mean power developed being 27,416 shaft horse-power, while the coal consumption was 1.78 pound per shaft horse-power per hour. On this run also the ship made six runs over the measured mile, the mean results being: revolutions, 300; shaft horse-power, 27,426; and speed, 20.8 knots. The machinery throughout worked satisfactorily.—*Engineering.*

GUN TRIALS OF "THUNDERER."—The battleship *Thunderer* left Spithead on March 14 for her gun trials; she returned in the evening, and reported that the trials were satisfactory. Her guns were fired first in pairs, gradually increasing the number of simultaneous discharges until the whole broadside was fired, first with half charges and then with full charges. The trials, it is understood, proved satisfactory, the structure of the vessel developing no weakness.—*United Service Gazette.*

ROLLING OF BATTLESHIPS.—The *Monarch* and *Orion* have had their bilge keels removed and replaced by larger ones in the endeavor to counteract their excessive rolling at sea. The *Orion* will also carry out tests with a number of different forms of propellers.—*United Service Gazette.*

"LIONS." ALTERATIONS.—The changes affecting the fire-control, secondary armament, conning-tower, masts and bridge fittings of the battle-cruiser *Lion* are considered likely to have a far-reaching effect on the designs of future *Dreadnoughts.*

Taking the fittings in the order named, the change in the position of the principal range-control instruments from the lofty and exposed platform built around the head of the tripod mast to the conning-tower, which is to be enlarged and raised to accommodate them, is of extreme importance, as it eliminates the risk to which these important instruments would be exposed either by the destruction of the supporting platform itself or the cutting of its electrical communications by shell fire; consequently the fighting efficiency of the *Lion* and her sister vessels will be increased by the armor protection afforded to the instruments, and the superiority thereby gained will be further enhanced by the fact that additional sets of range-finding and control instruments are provided, also behind armor.

The placing of the principal sets of instruments at a lower level may at extreme ranges militate to some extent against the accurate markings of shots, other than direct hits, but this will be provided for by a platform on the new mast for the accommodation of a small "spotting" staff. This change in the position of the principal ranging instruments from an exposed to a protected position has been anticipated in the fleet, where it is welcomed as a distinct gain in efficiency.

Another important change in connection with the *Lion's* armament is the conversion from open unprotected battery positions to enclosed protected casemates for the 4-inch anti-torpedo guns, the *Lion* being the first battle-cruiser in which casemates for these guns are being fitted, thus affording them that protection which naval opinion has called for. This change, together with the alteration to the conning-tower, has necessitated a remodeling of the fore superstructure and the bridge, the effect of which will be an all-round gain in efficiency as effecting the 4-inch armament, searchlight and navigating equipment.

To reduce the ill effects of the highly heated escaping gases from the funnels, it has been decided to considerably increase their height, and this, with a change in their shape and position, will, it is thought, secure the desired result.

Similar alterations will, it is understood, be worked into the *Orion* class almost immediately, and in earlier *Dreadnought* groups as opportunities occur, and will also form part of the equipment of the *King Gorge V* class.—*Naval and Military Record.*

This vessel was to have been commissioned last November, but will not join the fleet till end of May.

DEFECTS IN "LION."—For some unintelligible reason the fire-control mast in these ships is perched as near the forward funnel as possible. The volume of hot gases makes the fire-control platform untenable. It is, therefore, being removed from the mast-head to the conning-tower. The more elevated the control the greater the hitting powers at any range over four miles. By lowering the control station to half its original altitude in the *Lion*, the spotting capacity upon which effective marksmanship depends at long range is minimized greatly. This is very foolish in a type of ship designed originally for long range fighting, with the greatest speed and the heaviest guns to enable her to choose her own tactical position. It should not have been difficult to find a solution to this original error of design without such a serious sacrifice of aggressive precision.—*Shipping*, Illustrated.

The above alterations have been necessitated by the heat from the foremost funnel having been found so great in the course of the official steam trials that when all the boilers were in use it twisted some of the fittings on the navigating bridge, warped the woodwork, and generally made the conditions unbearable for those on duty there. It was also found that the heat from the funnel seriously affected the ship's compasses and other delicate instruments on the bridge and in the fire-control platform which forms part of the tripod mast. The positions of the masts will be reversed, and the foremost of the three funnels will be shifted further aft.

SECOND-CLASS CRUISERS.—There are fifteen of this class now under construction or completed since 1909. The length is 430 feet in all, but the beam has increased from 47 feet to 49.5 feet, draft from 15.25 to 15 feet 10 inches, the displacement rising from 4800 to 5440 tons. The average speed has been 26 knots. They are twin-screw turbine vessels, with I. H. P. of 22,000 to 25,000. Each shaft has independent units for the complete range of steam expansion, from boiler pressure to condenser vacuum. There is an impulse wheel at each high pressure end.

Armament is eight 6-inch guns. Two submerged torpedo-tubes. Their fuel capacity gives a large radius of action.—*Engineering.*

H. M. S. *Attack*, one of the special destroyers with superheaters, built for the British Admiralty by Messrs. Yarrow, of Glasgow, had a very successful official full-speed trial on Saturday, March 30, on the Skelmorlie deep-water-measured mile at the mouth of the Clyde, attaining a mean speed during a continuous run of eight hours of 30.6 knots, thus exceeding the contract speed of 28 knots by 2.6 knots.

The vessel is 240 feet long by 25 feet 7 inches beam, propelled by Brown-Curtis turbines driving twin screws, steam being supplied by three Yarrow water-tube boilers fitted with the firm's most recent superheating and feed-heating devices.

NEW BRITISH DESTROYERS.—The twenty ocean-going destroyers for which tenders have been invited will be of an improved design, the principal characteristics of which will be increased sea-keeping qualities, combined with a superior armament, both gun and torpedo, the power of the latter being doubled. Compared with their immediate predecessors, the *Acorn* and *Acheron* classes, there will be an increase of nearly 50 per cent in displacement, viz., from 780 to 1100 tons; an increase in dimensions from 240 x 25½ to 265 x 27 feet; in armament from two 4-inch and two 12-pounder guns to three 4-inch, while two new design double 21-inch tubes are to take the place of the two single 21-inch now mounted, thus giving an increase of 100 per cent effective torpedo power.

The improvement in torpedo armament is considered of great importance, inasmuch as it will not only double the striking power of each unit, but will also relieve the strain on the storage capacity of the depot ships to a corresponding degree.

In speed and fuel capacity the new vessels will also be superior to their immediate predecessors.—*Naval and Military Record.*

SIZE OF SUBMARINES.—The orders for still larger submarines indicate that there is continued advance in this connection. Indeed, now that it seems certain that the submarine carrying one or more guns in addition to an armament of torpedoes has come to stay, there is a possibility that before long the powers may cease to build destroyers and torpedo-boats and concentrate their energy entirely on under-water craft. The idea of the submarine as a daylight destroyer has been accepted for some time, and surface torpedo craft have therefore come to be mainly associated with night attack and defence. But if, besides being armed with guns, the submarine can be equipped with the high speed and radius of action of the destroyer it may develop into a vessel for night use also, replacing the destroyer in that sphere of work as it has already done for operations by day. At present, however, it is scarcely equal to an ocean-going destroyer in point of size, and considerable progress must still be made before it can be an efficient substitute for the latter in the manner referred to. During the last five years or so the development of British submarine construction has been very rapid. The numerous boats of the "C" class, the construction of which made our relative position as regards submarines unrivalled in the world, were followed by the eight vessels of the "D" class, which were not only larger and better sea-going boats, but in which wireless was introduced, and also guns for offensive use. Next there were begun last year the six boats of the "E" class, which showed an all-round advance on those of the "D" type, and now that the time has come for the 1911-12 boats to be ordered, two have been allotted to Chatham as usual, three to Vickers, and one is to be of a novel type to be built by the Scotts' Company, of Greenock. The design of the last-named is on the plan of the Italian constructor Laurenti, which is understood to include improvements in the design and shape of the vessel.—*The Army and Navy Gazette*, Feb. 10.

THREE SUBMARINE TENDERS.—The submarine tender *Adamant* and her sister the *Alecto*, were both constructed by Cammell, Laird & Co., Limited, of Birkenhead. They are of 935 tons displacement, with a horse-power of 1400. The designed speed is 14 knots.—*Engineer.*

They are fitted with reciprocating engines of 1400 horse-power, which gives them a speed of 14 knots. Internally, she has large accommodation for storing torpedoes, and workshops for carrying out repairs. The sheerlegs fitted aft—of about 5 tons capacity—are to enable torpedoes to

be lifted out of the water, and, on occasion, weights out of the submarine boats in connection with repairs at sea.—*Engineering.*

The submarine is in no way so self-supporting as a big ship. Like the destroyer, her efficiency depends almost, if not entirely, upon a suitable mother ship, which carries the necessary stores and spares. Up till now old gunboats or cruisers have been utilized for this purpose, but such vessels are obviously makeshifts, and in no way to be compared with craft specially designed for the purpose for which it is intended to use them.

The *Adamant* and *Alecto*, which are replete with all the latest requirements for the particular service they were designed for, are intended to replace two of the old warships now extemporized for depot work. Both vessels are to have sheerlegs and a tripod at the stern for towing disabled submarines.

From the Carlsdyke yard of Scott's Shipbuilding & Engineering Co., Greenock, there was launched on April 29 the submarine depot ship *Maidstone*, which, like the two foregoing, has been designed to be a "mother ship" for supplying the needs of submarines during the course of long voyages. She is a vessel of 3600 tons at load draft, and will have propelling machinery of 2800 indicated horse-power. She is to carry stores for a submarine fleet, and, while not intended to undertake long voyages, she will be able probably, with coaling help from a fleet at sea, to obtain a very considerable radius of action.

All the emergency gear which has stood the test of practical everyday use in the old submarine tenders will be embodied in this new "mother ship." Elaborate workrooms, with powerful electric plant, will be a feature of the vessel, and all well-approved means of tackling and lifting submarine craft—strong hawsers and jacks from the side of the vessel—will be provided.—*Engineer.*

THE SALVING OF THE SUBMARINE BOAT "A3."—The damage caused by the collision of the submarine boat *A3* and the gunboat *Hazard* has been proved to be very serious. One of the rudders of the *Hazard* has been found jammed into the conning-tower of the submarine boat, and the injury to the propeller disclosed when the gunboat was docked gives rise to the belief that it acted as a knife to rip the upper shell-plates of the submarine boat. These facts, which are supported by divers' observations, make it quite certain that no air-helmets or other appliances on board could have obviated the loss of life. Moreover, they raise doubt as to the advantage of attempting to salve the vessel.—*Engineering.*

The ill-fated *A3* is one of the earlier types of submarines built for the British Navy, and is now practically obsolete for all purposes except that of coast and harbor defence. She was launched in 1903, and has a displacement of 204 tons with an indicated horse-power of 110 submerged and 450 on the surface, her speed being seven knots below and twelve above.—*Page's Weekly.*

HOSPITAL SHIP.—British Admiralty design contemplates a vessel of 5000 tons displacement, steam turbines, and burn oil. She will be a sea-going hospital with operating rooms, laboratories, and dispensary. There will be various wards. An elaborate communication telephone system is provided. The designing is under direction of Sir James Porter, the medical director general of the navy. It is the first ship ever built in the world for solely hospital purposes. Cost will be $707,500.

NAVAL COALING.—During the recent combined cruise of the second division of the home fleet and the Atlantic fleet, ships coaled from colliers at Arosa Bay, with the following results:

	Tons.	Average per hour.
Colossus	829	355.3
Hercules	875	328.2
Britannia	558	318.9
Agamemnon	616	284.3

Coaling at Portland from lighters, the battleship *Neptune*, flagship of Admiral Sir G. A. Callaghan, took on board 750 tons in 1 hour 30 minutes actual time from the moment the first coal was shovelled into bags in the lighters until the last batch of bags was dropped on the deck. The coaling party went on board the lighters at 10.57 a. m., and at 12.40 p. m. they had returned on board the *Neptune*.

Four lighters were used, two being fitted with Temperley transporters and two with ordinary gear.

Admiral Callaghan has addressed a general message to the crew of the *Neptune* congratulating them upon their smart performance in beating the world's record in coaling from lighters.—*Naval and Military Record.*

GOOD COALING UNDER ADVERSE CONDITIONS.—On the return to Portland of the second division of the home fleet from Torbay preparations were made to complete the ships with coal from the dockyard stock. The coal was transferred to the ships by lighters, except in the case of the *Falmouth* and *Bristol*, which proceeded alongside the coaling jetty. The averages were good when the conditions of coaling are considered. A gale was accompanied by heavy seas, and the coal lighters were continually washed down. Results:

	Tons received.	Average per hour.
Indomitable	1,250	269.5
Bristol	500	210.6
Falmouth	300	209.7
Colossus	980	174.5
Warrior	750	169.8
Hercules	800	168.8
Lord Nelson	880	140.5
Achilles	900	120.2
Britannia	630	78.5

On arrival at Gibraltar we coaled to maximum stowage, in a gale and deluge of rain. Some good results were obtained, the *Triumph* creating a third record in succession, this time having made the highest known average for coaling alongside at Gibraltar. Following are the results:

Ship.	Amount taken in. Tons.	Average. Tons.
Triumph	700	344.26
Swiftsure	890	290.2
Exmouth	950	193.2
Duncan	965	193
Russell	1,017	150.6
Cornwallis	840	148.23

—*The Naval and Military Record.*

COMMISSIONING OF WARRANT OFFICERS.—A real avenue from the mess-deck to the quarter-deck is now to be formed. As the First Lord of the Admiralty has announced, the Board will select from among the younger warrant officers from 25 to 30 annually for advancement to the rank of commissioned warrant officer, and these selected officers, the best possible representatives of the lower deck, will be eligible for further promotion to the ranks of lieutenant and commander. This important change is to be effected for two reasons. Firstly, it will enable the Admiralty to increase more rapidly the number of executive commissioned officers, and, secondly,

the step is designed to satisfy those legitimate aspirations of the fleetmen which have long been supported by this journal. Henceforward commissioned rank in the real sense will be open to the best men of the Royal Navy, and the reform will also tend to stimulate competition for promotion to warrant rank. We are sufficiently in touch with the views of naval warrant officers to be able to say with confidence that both seniors and juniors will unite in welcoming the reform. The seniors will be satisfied to attain promotion to commissioned rank after fifteen years service, and will be content that higher ranks on the active list are to be opened to their juniors. Mr. Churchill's explanation implies that selected warrant officers will enjoy opportunities of reaching the rank of commander on the active list, while a larger number will become lieutenants and commanders on the retired list.—*The Naval and Military Record.*

NAVAL ACCIDENTS.—July, 1911. The sea-going destroyers of the *Acorn* class, about 800 tons displacement, and built especially to keep the sea in all kinds of weather, during the maneuvers of the home fleet, proved so unseaworthy that eight were compelled to give up the exercises and return to port for a long period of repairs.

August, 1911. The Canadian cruiser *Niobe* struck the rocks off Cape Sable, and the English cruiser *Cornwall*, endeavoring to give her assistance, struck near her.

September, 1911. The submarine *A-1*, used for training, sank, fortunately, when no one was aboard.

November, 1911. At target practice the battleship *Hindustan* was struck on her quarter by a shell from the battleship *Colossus*. Some days later the chase of a 3-inch gun blew off on the *Nymph*, destroyer, killing one officer and three men.

December, 1911. The oil in the crank case of a dynamo exploded on the battleship *Orion*, seriously wounding 17 men and 3 officers.

February, 1912. Submarine *A-3* was sunk by her tender, the Hazard, and all on board lost.

May, 1912. The British battleship *Empress of India* was in collision on the second with a German sailing vessel at Spithead. The battleship received a gaping hole in her side above the main deck, while the merchantman lost headgear and foretopmast.

The *Empress of India* was in mid-channel in tow of the cruiser *Warrior* at the time of the crash.

NEW ORGANIZATION OF BRITISH FLEET.—*New Classification.*—The term "division" is restricted to its familiar signal-book meaning as a tactical unit of variable quantity applicable to any part of a body of ships grouped together for tactical purposes. The home fleet and ships are classed in fleets according to the status of the commission in which they are maintained by their lordships, ships in the first fleet being in permament commission with full crews, ships in the second fleet being in commission with nucleus crews and receiving full complements of active service ratings on mobilization, ships in the third fleet being in commission with reduced nucleus crews, or in the "Matériel Reserve" and requiring reserve men on mobilization. These fleets are therefore administrative and not tactical classification.

The home fleet thus divided into three fleets will comprise eight squadrons. Each squadron will consist of a battle squadron and cruiser squadron and attached ships numbered consecutively. Four squadrons will form the first fleet, two the second fleet, and two squadrons and three additional cruiser squadrons the third fleet.

Training Squadron.—The present fourth cruiser squadron will in future be known as the training squadron.

Mediterranean Fleet.—The present sixth cruiser squadron will in future be known as the Mediterranean cruiser squadron.

Eastern Fleet.—This fleet will comprise the China squadron, Australian squadron, East Indies squadron. Other vessels on foreign stations will continue to be designated as at present, but the vessels employed in Newfoundland, the West Indies, and on the southeast coast of South America will, if combined, be known as the west Atlantic squadron.

Flotillas reorganized.—The organization of the destroyer flotillas will conform to the foregoing system. The present first, second, and seventh flotillas will be reorganized into four flotillas, to be known in future as the first, second, third, and fourth flotillas. The present third, fourth, and fifth flotillas (nucleus crews) will be also reorganized into four flotillas, to be known in future as the fifth, sixth, seventh, and eighth flotillas. The vessels composing the present sixth flotilla will in future be included in the home port flotillas.

The first, second, third, and fourth flotillas will in normal circumstances be under the orders of the commander-in-chief of the home fleets. The fifth, sixth, seventh, and eighth flotillas will form the command of a flag officer, styled "Admiral of Patrols." This officer will be under the direct orders of the Admiralty.

The submarine sections in home waters will also, from May 1, be rearranged in nine sections. They will remain under the general control of the inspecting-captain of submarines, who will be responsible to the commander-in-chief of the home ports for those sections where assigned to port defence, and will be responsible to the admiral of patrols for the remainder.—*Naval and Military Record.*

ITALY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Dante Alighieri	19,000	Gov't Yard, Castellamare.	Launched Aug. 20, 1910.
Cavour.	22,000	" " Spezia.	" Aug. 10, 1911.
Giulio Cesare	22,000	Ansaldo-Armstrong.	" Oct. 15, 1911.
Leonardo da Vinci ...	22,000	Genoa (Odero).	" Oct. 14, 1911.
Andrea Dorea	25,000	Spezia.	Building.
Duilio	25,000	Castellamare	"
Scouts.			
Quarto.....	3,400	Venice.	" Aug. 19. 1911.
Marsala	3,400	Castellamare.	" Feb. , 1912.
Nino Bixio.....	3,400	"	" Dec. 28, 1911.

The *Rivista Nautica* states that the Italian Board of Admirals has decided to build super-*Dreadnoughts* of 29,000 tons displacements and 25 knots speed with an armament of ten 14-inch and twenty 6-inch guns. The estimated cost of such a battleship is $18,000,000. The Italian Navy will increase her fighting fleet by 10 *Dreadnoughts* to be laid down in the near future. While the Italian Navy has not yet a single *Dreadnought* in commission there are six building and not yet completed.—*Marine Rundschau.*

DOCKS.—The floating and experimental dock for Italian submarines has been completed by the Fiat Company and a second dock, capable of going to sea with its own power, is being built at the Fiat Company's works at Spezia.—*Marine Rundschau.*

In view of the increased naval problems by the acquisition of Tripoli and Cyrenaica it is contemplated to considerably increase the strength of the Italian Navy and also that of the Austrian Navy that these two navies may be superior to that of France. The two triple alliance countries can at present only oppose a combined force of 17 battleships against 22 French battleships and as the new French program provides for 28 *Dreadnoughts* or super-*Dreadnoughts,* Italy should, in 1920, have an additional 15, and Austria 10 battleships.

The armament of the *Andrea Doria* and *Duilio* will comprise fifteen 12-inch mounted in five triple turrets. The armor belt will have maximum thickness of 10.5 inches. Their speed will be 23 knots, with horse-power of 38,000. Are 525 feet long, and 88.5 feet beam, drawing 29 feet.

All Italian battleships have Bullivant torpedo-nets.

Italy is building 14 destroyers of 600 tons, two of these will have motor engines.—*Marine Rundschau.*

SUBMERSIBLE BOAT "ATROPO."—This boat was launched on March 22. Her principal dimensions are the following: Length, 146 feet; beam, 14 feet 5 inches; displacement (submerged), 320 tons.

When the boat is run on the surface, her two propellers are driven by two-cycle oil engines of Messrs. Krupp's own type, and aggregating 600 effective horse-power. When submerged, she is driven by two electric motors, as in the case with all submarine boats. The contract speeds are 12.5 and 8 knots respectively on the surface and submerged. Her radius of action on the surface is 1300 miles, and under water 40 miles.—*Engineering.*

AUXILIARY VESSEL.—The Italian cruiser *Giovanni Bausan* is to be converted into a distilling and tank ship.—*Marine Rundschau.*

PERSONNEL NOTES.—New Italian regulations provide that cadets shall enter at ages from 12 to 16, take four years training and education, when they shall be eligible to commissions as officers at ages of from 16 to 20. The old regulations provided for entrance ages of 17 to 19 years.

December 31, Italy had 35,753 men in the navy exclusive of officers. 5830 of these men belong to the different categories of reserves.

During the first nine months of 1911 the Italian Navy was being prepared for the war with Turkey. The most notable feature was in the personnel of officers. Ninety-nine officers, who were inferior in qualifications, were retired from service. Eight of the nine vice-admirals who were on the active list at the beginning of the year were retired, three because of having reached the age limit, and five were compulsorily selected out, leaving the squadron commander "Aubry" the only one in active service.

The recruiting and training of officers has been remodeled according to the British methods. The strictest regulations are being enforced for officers to qualify for promotion and a strenuous system of selecting out has been adopted.

The peace strength of the personnel has been fixed at 28,500 men and active service limited to three years with special rewards for continuous-service men.—*Marine Rundschau.*

NAVAL ACCIDENTS.—February, 1911. While exercising at anchoring mines at Spezia, one exploded prematurely and three men were killed and two wounded.

August 12, 1911. The battleship-cruiser *San Giorgio,* one of the best and most powerful units of the Italian fleet, was badly wrecked on the rocks of Posilippo. She was refloated and left her dock completely repaired and took her place in the squadron on April 2, 1912.

September 18, 1911. The destroyer *Pontiere,* having run aground, was completely wrecked by a hurricane which caught her while in that unfortunate predicament.

SALVAGE OF THE "SAN GIORGIO."—This vessel, while entering the harbor of Naples on August 12, 1911, steaming at 13 knots, ran ashore on Gaiola Shoal off Posilippo Point.

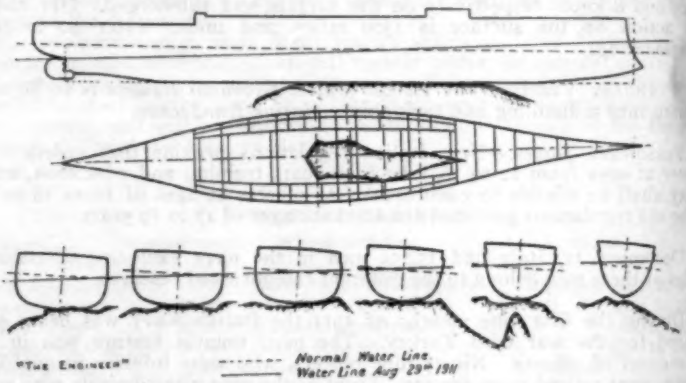
The *San Giorgio* is a four-funnelled armored cruiser completed in 1911, displacing, when she struck, 10,580 tons, 430 feet long, 68.75 feet beam, with speed of 22.5 knots, and armed with four 10-inch, eight 8-inch, and sixteen 3-inch guns.

Water poured into the fore and amidships double bottom and powder magazines, the stokeholds, the longitudinal and transverse bunkers, and the entire fore part of the vessel up to the engine room bulkhead. The Kingston valves were sprung out of place so that the condenser pumps had to run night and day to save the engine room from being entirely flooded.

The ship took in about 4300 tons of water, and was in a very unstable state of equilibrium, and exposed to the dreaded libeccio (southwest) gales.

She was first secured by two anchors from the bows, and one towards the southwest, and these moorings were strengthened after three days. Battleships anchored to windward continually to afford a lee for operations.

The work was under the immediate direction of General Valsecchi, the head of the corps of naval engineers.



POSITION OF THE SHIP ON THE ROCKS, AUGUST 29, 1911. SHE WAS UP BY THE STERN WITH SUBMERGED TORPEDO-TUBE ABOVE WATER, AND WAS CANTED 6 DEGREES TO STARBOARD.

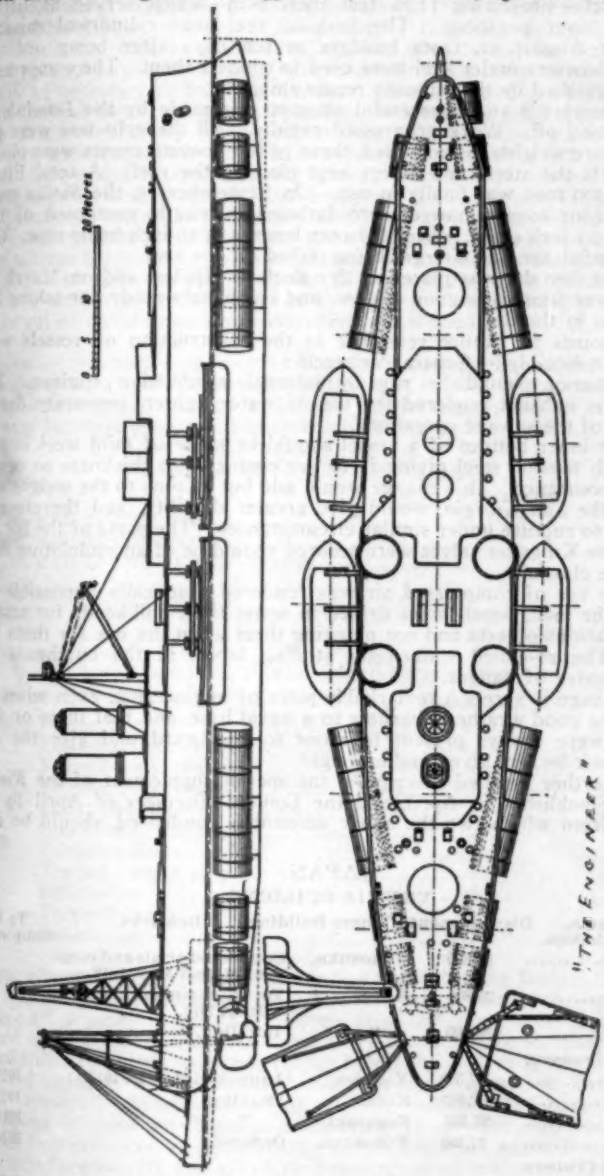
There were four stages into which the operations were divided, all of these proceeding simultaneously:

1. Lightening the ship. This was done by large floating cranes. Removal of coal, fresh water and stores made but 600 tons difference. The guns and mechanism with fore and aft conning-towers made 1070 tons, and the amount of armor eventually stripped off was 95 tons. The two fore funnels were also sent ashore.

2. Expulsion of water. The steam pumps on board were used—a pumping plant was assigned to the various sections of the vessel. Dams of cement made as the work progressed. Collision mats, strengthened first by placing steel nets and cushions of tow over the holes, were used to stop leaks. The compartments representing exceptional difficulties were filled with cork, barrels and earthenware jars. When the forward torpedo room was cleared a centrifugal pump of 200 tons, and a piston pump of 40 tons were set up therein. The capstan room next was used similarly, and so on. The two fore boiler rooms, 49,392 cubic feet of water, were prepared for clearing by compressed air.

3. Cutting away the rock. Small charges of dynamite were used to blast away portions of the rock, and these had scarcely any appreciable effect on the friable volcanic tufa which opened up in fissures instead of splintering.

4. Use of external lifting appliances. Use of slings under her keel was limited to her extremities. Six cylindrical iron caissons were obtained each with a lifting thrust of 350 tons; dimensions, 65.6 feet long by 16.4



PLAN OF THE DISTRIBUTION OF CAISSONS AND PONTOONS, SEPTEMBER 14-15, 1911.
ON THIS OCCASION THE VESSEL WAS GOT OFF.

feet in diameter. Eight smaller ones of 55 tons thrust each were obtained. The cylindrical form was found to be very advantageous. Six wooden-decked pontoons of 150 tons each lifting capacity were also obtained. The

total lifting power was thus 3440 tons. This is without counting the powerful floating cranes.

Armor was stripped from ship's side so as to secure thereto six pairs of iron brackets—projecting 14.76 feet therefrom—which served as lifting points for four pontoons. The first of the large cylindrical caissons arrived on August 31, from builders or ten days after being ordered. Five steel hawsers under keel were used to connect them. The compressed air was furnished by the Vulcano repair ship.

On September 8 an unsuccessful attempt was made by the *Dandolo* to tow the vessel off. Work progressed rapidly. All the cylinders were put in place, more weights disembarked, three 75-ton floating cranes were placed so as to lift the stern, and divers kept blasting the reef. A total lifting force of 2500 tons was finally in use. On September 15, the *Sicilia* made fast with four towing hawsers 270 fathoms in length, composed of two lengths of 2.4-inch chain, spliced between lengths of 19-inch hemp rope. This was successful, the *San Giorgio* being pulled off the reef.

The next day she was placed in dry dock at Naples, and on March 21, 1912, she was floated, as good as new, and completely ready for taking her place again in the fleet.

These points for future reference in the construction of vessels were brought out forcibly by General Valsecchi:

(1) Dynamos should be run by internal combustion engines. The atmospheric exhaust rendered the use of water lighters necessary during the whole of the salvage operations.

(2) The inner bottom of a vessel should be made of mild steel instead of the high tension steel giving it 10 per cent greater thickness to ensure the same resistance. This change would add but 12 tons to the weight of a ship like the *San Giorgio*, would give greater ductility, and therefore be less likely to rupture under similar circumstances. The parts of the bottom whereto the Kingston valves were secured should be of an undulating form to increase elasticity.

(3) The use of compressed air was rendered practically impossible because of the many small holes drilled in water-tight bulkheads for attachment of various objects and not plugging them when the use for them had ceased. The so-called water-tight stuffing boxes in the bulkheads are another source of danger.

This salvage is surely a remarkable piece of engineering, even when the facts of the good weather, nearness to a naval base, and that three or four warships were always present to moor to windward and give the *San Giorgio* their lee, are given undue weight.

For a further detailed description the special supplement of the *Rivista Marittima* published in April, and the London *Engineer* of April 19 and 26, 1912, from which two the above account is condensed, should be consulted.

JAPAN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.	To be completed.
Battleships.				
Kawachi	20,800	Yokosuka.	Completed trials and commissioned May, 1912.	
Settsu	20,800	Kure.	To be commissioned July, 1912.	
Fuso	30,000	"	Building.	
Armored Cruisers.				
Kongo	27,500	Vickers.	Launched May 18, 1912.	1913
Haruna	27,500	Kobe.	Building	1915
Kirishima	27,500	Nagasaki.	"	1915
Hiyei	27,500	Yokosuka.	Ordered.	1914
Protected Cruisers.				
Shikuma	5,000	Sasebo.	Launched Apr. 1, 1911.	1912
Yahagi	5,000	Nagasaki.	" Oct. 3, 1911.	1913
Hirado	5,000	Kobe.	" June 29, 1911.	1913

JAPANESE NAVAL EXPANSION.—The *Tokio Asuhi* credits the Minister of the Navy with the following statement at a secret session of the Fourth Section of the Budget Committee in reply to an interpellation on the contemplated naval expansion program, postponed from the present year.

The Minister is reported to have said: "It is impossible to tell with exactitude just now how the naval scheme is to be carried out from the fiscal year 1913-1914, but if the financial condition of the government allows it will be necessary to build 18 vessels to form a unit of the fighting line—eight battleships of the super-*Dreadnought* type and eight (possibly only six) armored cruisers of the latest type. In addition, sixteen smaller cruisers and special service vessels must be constructed, but the cost of these latter would be comparatively small. The whole of this new fleet must be constructed in seven years from next year, 1913. Possibly if the financial conditions are stringent the period could be extended to ten years. As a seven-year scheme the annual appropriation would be $25,000,000, as a ten-year scheme $17,500,000. Without these sixteen vessels it would be possible for Japan to fight any battle worthy of the name against the 21 big ships which a certain power will have at that time. This forms the irreducible minimum of naval expansion.—*Shipping*, Illustrated.

Even if America continues to lay down two *Dreadnoughts* or super-*Dreadnoughts* a year her strength in this type of ship in 1920 will, as compared with that of Japan, be as follows, on the assumption, of course, that the new Japanese program is adopted and completed to time:

Completed Dreadnoughts in 1920.

	America.	Japan.
Armed with 12-inch guns	8	2
Armed with 14-inch guns	4	4
Armed with 14-inch or heavier guns	12	17
	24	23

—*Scientific American.*

JAPANESE NAVAL CONSTRUCTION, 1912.

	Completed.	Building.
Battleships	13	3
First-class cruisers	13	4
Second-class cruisers	9	3
Third-class cruisers	8	..
Coast defence vessels	7	..
Gunboats	4	1
Despatch boats	6	..
Torpedo depot ships	2	..
Destroyers	58	2
Torpedo-boats	57	..
Submarines	12	1

THE BUDGET.—The Marine Minister Saito stated to the Budget Committee that Japan requires 18 super-*Dreadnoughts* which should be built in the course of 7 years after 1913. When Minister Saito was questioned in regard to this reported government policy to so largely increase the navy he said that the plans were not ready to be published as it was a secret of national defence, but he stated that it was contemplated to have 6 additional armored cruisers instead of 8. The contemplated program of 18 new ships includes the *Kawachi* and *Settsu*, as also the *Aki*, which, latter, would, however, not be equal to the newer proposed super-*Dreadnoughts* of which they want 8, and also 6 or 8 new armored cruisers. The financial conditions are such that this increase is postponed another year.—*Marine Rundschau.*

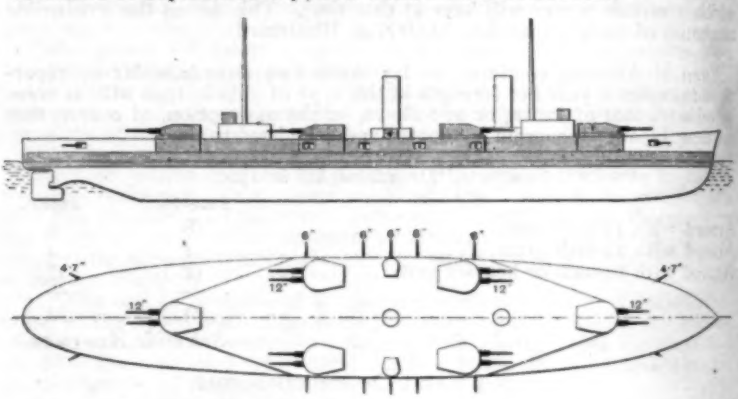
Among other features of the new budget there is a sum of $19,500 for entertaining foreigners.

In a comparison of the personnel strength of the navies of England and Japan it is claimed that there is no need for having any cadets enter the Japanese Navy during the next few years because the comparison shows:

Warship.	Displacement. Tons.	Officers.	Men.
England	2,105,450	4818	104,300
Japan	465,765	3034	52,800

DOCKS.—The floating dry dock that has been building at Sasebo during the past four years has been launched. This has a capacity of 30,000 tons, length 776.8 feet, width is 331 feet. This is the largest dock in Asiatic waters at the present time.—*Marine Rundschau.*

The battle-cruiser *Kongo* will leave Vickers' works shortly under the command of Captain Idekenji, now naval attaché at London.



"KAWACHI." "SETTSU."

Length, 480 feet; 20,800 tons; speed, 20.5 knots; building; armament, twelve 12-inch; ten 6-inch; twelve 4.7-inch.

—From *Brassey's Annual.*

The fast battleships *Kongo, Haruna, Kirishima,* and *Hiyei* will each have eight 13.88-inch guns. This new gun will weigh 86 tons and will fire a shell weighing 1861 pounds. The life of each gun is to be 250 shots with full charges.

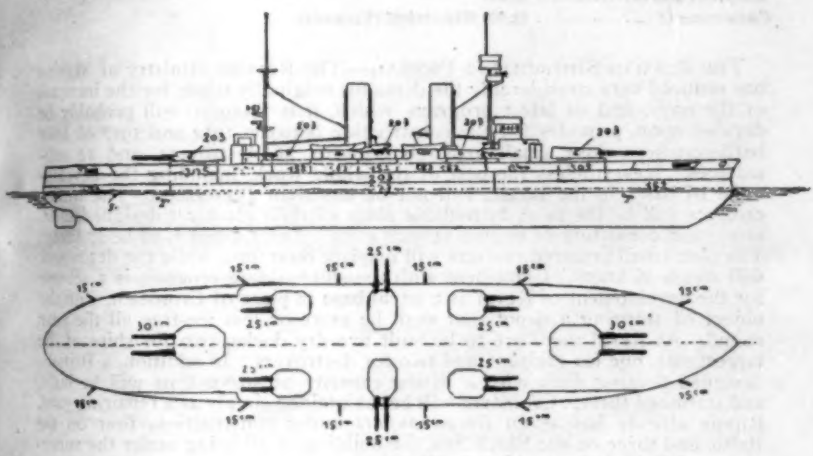
Speed will be 25 to 27 knots with 75,000 horse-power. The armor at water-line is 9.9 inches thick. They will have sixteen 6-inch guns. The battle-ship *Fuso* is reported to be of 30,000 tons and to mount 15-inch guns.

"AKI" AND "SATSUMA."—The *Aki* and *Satsuma,* recently commissioned, are the first large battleships to be built in Japan, and consequently much interest attaches to them. The latter was built at Yokosuka, the former at Kuré. There was a lapse of five years between the laying down and commissioning of the *Aki,* but during this period much other construction work was underway. Much discussion has been caused by the fact that the Japanese have held to the six-inch and eight-inch guns; or to a three-caliber ship, and they are presumably reasoning from lessons of the late war. There is, however, reason to believe that the departure from the "all-big-gun" ship was due to the fact that the Japanese Admiralty considered the difficulty of building such at that time too great to conquer.

The *Satsuma* is a bigger and better *Lord Nelson*, and is the last word in the three-caliber ship. The *Kawachi* and *Settsu*, now under construction, carry only twelve 12-inch guns. The *Aki* is slightly the larger of the two ships.

The portion of these ships protected by armor is greater than that in the *Lord Nelson* and much greater than that in the *Danton*. The *Danton* has the most freeboard. These Japanese ships are superior to the *Lord Nelson* and *Danton*.

The *Aki* has Curtis turbines, and the *Satsuma* reciprocating engines, and the latter has one less funnel than the *Aki*. The *Aki* made easily 21 knots with 25,000 horse-power, while the *Satsuma* made but 20.5 knots with 18,500 horse-power. The boilers are Japanese, *Mijabara*. The turrets are worked both electrically and hydraulically. Both vessels carry torpedo-nets.—*La Vie Maritime*.



"AKI."

Length, 481 feet; beam, 83.3 feet; draft, 28.5 feet; displacement, 19,250 tons; armament, four 12-inch; twelve 10-inch; twelve 6-inch; four 3-inch; 5 submarine torpedo-tubes.

SOME NAVAL ACCIDENTS.—November, 1911. A charge exploded in a 12-inch turret while proving the gun. All the mounting was wrecked and 10 men were killed.

The torpedo-boat destroyer, *Harukase*, struck by a gale, was lost, with 45 men of her crew.

The breech block of a 30.5-cm. gun was blown out at target practice in Aomori Bay by which 10 men were killed.

PERU.

Peru purchased the old French armored cruiser *Dupuy de Lome* for $600,000. This vessel left the *Lorient* in April, 1912, for Callao. The firm of Creusot is now building a submarine of *Laubeuf* type for Peruvian Navy.

PORTUGAL.

PROGRESS IN 1911.—Portugal has adopted a naval ship building program to provide the republic with three battleships each of 20,000 tons, three scouts of 3500 tons, 12 destroyers of 820 tons, and 6 submarines of 350 tons.

They also will have 3 wireless stations. Total cost for Portugal is estimated at $40,750,000. The Portuguese cruiser *San-Rafael* was stranded and lost. Her crew were all saved October 21, 1911.—*Marine Rundschou.*

RUSSIA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Sevastopol	23,000	St. Petersburg (Baltic Wks.).	Launched June 23, 1911.
Petropavlovsk	23,000	" "	" Sept. 8, 1911.
Poltava	23,000	" (Admiralty Yd.).	" July 10, 1911.
Gangoot	23,000	" "	" Oct. 7, 1911.
Emperor Alexander III.	22,500	Ivan Bunge Co. (Clydebank).	Building.
Empress Marie	22,500	" "	"
Catherine II	22,500	Nikolaieff (Vickers).	"

THE RUSSIAN SHIPBUILDING PROGRAM.—The Russian Ministry of Marine has reduced very considerably the demands originally made for the increase of the navy, and its latest program, which, it is thought, will probably be decided upon, provides for the construction between 1912 and 1917 of four battle-cruisers, four small armored cruisers, 36 destroyers, and 12 submarines. Nevertheless the cost of the whole work, including the development of bases in the Baltic, will not be less than £54,000,000. The battle-cruisers will be the most formidable ships of their class yet designed, their armament consisting of twelve 14-inch guns. Their speed is to be 27 knots. The four small armored cruisers will displace 8000 tons, while the destroyers will steam 36 knots. Coincident with the shipbuilding program is a scheme for the development of Reval as a naval base in place of Cronstadt, with the object of securing a depot that shall be more or less ice-free all the year round. At Reval there are to be built five dry docks, two for ships of the largest size, one for cruisers, and two for destroyers. In addition, a British-designed floating dock with a lifting capacity of 40,000 tons will be built, and stationed there. Cronstadt will be maintained simply as a repairing yard. Russia already has seven *Dreadnoughts* under construction, four on the Baltic and three on the Black Sea, the building of all being under the supervision of British firms.—*Page's Weekly.*

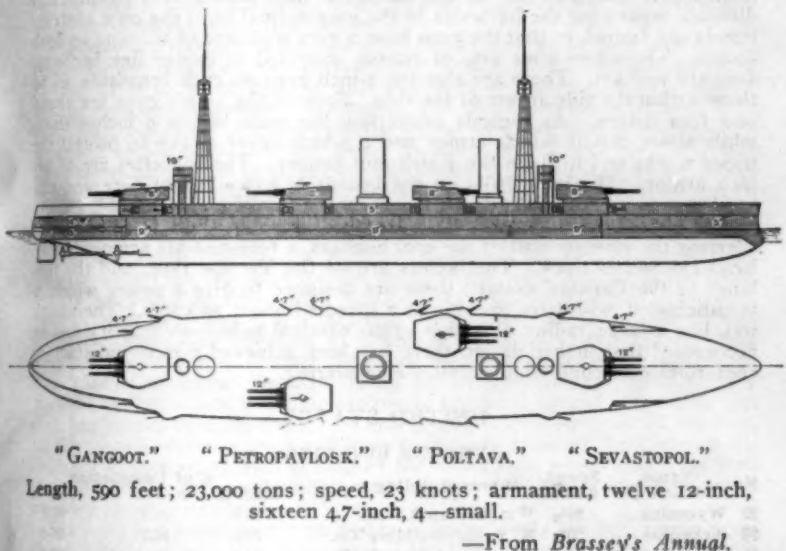
This program was adopted April 30, 1912.

THE RUSSIAN BLACK SEA FLEET.—A naval program which has just been submitted by the Russian Minister of Marine (Admiral Grigorovitch) to the Duma proposes that the Russian Baltic fleet shall have two squadrons, each comprising eight battleships, four armored cruisers, eight protected cruisers, thirty-six torpedo-boat destroyers and twenty-four submarines. The Russian Black Sea fleet, which is of secondary importance, is to be, at any rate, stronger than any two of the most powerful navies maintained in that sea; and the construction of the following new ships has been proposed: Three battleships, with a displacement of 22,000 tons each (two of these ships are to be built at Sebastopol and one at Nikolaieff, in Vickers' yards; the cost of these ironclads will be something over $10,000,000 each; one ship is already in course of construction at Sebastopol and the other at Nikolaieff; nine torpedo-boat destroyers of an improved *Novick* type, with a displacement of 1050 tons, and a speed of 35 knots (the estimated cost of each of these destroyers is $1,060,000; four are to be built in the Nicolaiff Arsenal); and six submarines, three of which are to be of the *Holland* type. Altogether, the program of Admiral Grigorovitch contemplates an outlay of $250,000,000; the admiral insists that it is necessary that Russia should have a powerful fleet as an essential condition of the integrity and independence of the country, and as a means of maintaining the peace of Europe.—*Shipping*, Illustrated.

A floating dock is to be built at Nikolaieff capable of accommodating the new *Dreadnoughts*. Designed to float 40,000 tons and to be completed March, 1912.

NOTES.—The schoolship *Rynda* has been fitted with Diesel motors. The Russian chain of wireless stations has been increased by new stations in Kamchatka and Siberia.

AUXILIARY VESSELS.—*The Russians are paying a great deal of attention to mine-laying vessels.* Three old ships were rebuilt and completed as mine layers, viz.: *Ladoga, Narowa* and *Onega*. The transports *Beresan* and *Schilka* are being converted into mine-laying vessels in the Black Sea. These mine-laying vessels are now organized into a squadron of mine layers under special command.—*Marine Rundschau.*



"GANGOOT." "PETROPAVLOSK." "POLTAVA." "SEVASTOPOL."

Length, 590 feet; 23,000 tons; speed, 23 knots; armament, twelve 12-inch, sixteen 4.7-inch, 4—small.

—From *Brassey's Annual.*

The Russian Navy will build at Nikolaieff a submarine boat for mine-laying purposes, 170 feet long and of 500 to 700 tons displacement, fitted with Curtis' turbines for surface cruising and electric motors for submerged runs. The boat will have two torpedo-tubes and will carry four torpedoes. The mine-laying outfit will be located in a caisson, built above the hull, divided in two compartments and running the whole length of the hull. Each compartment will stow 30 mines and mines will be laid from the after end by means of an endless chain.—*Shipping*, Illustrated.

The Russian school of aviation has received four flying machines of the Newport type. Sixteen more of this type have been ordered from France.

ARTICLES OF WAR.—The Czar has changed the Russian Navy regulations in regard to surrendering a ship of the navy so that it now reads: "It is the duty of the captain to destroy his ship when there is no possibility of continuing the action, and when there is any likelihood of being captured by the enemy.—*Marine Rundschau.*

SPAIN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
España.....	15,400	Ferrol	Launched Feb. 6, 1913.
Alfonzo XIII.....	15,400	"	Launched.
Jaime I	15,400	"	Building.

These ships are notable for the great fighting power embodied in limited dimensions. The length between perpendiculars is only 435 feet; the beam, 78 feet 6 inches; and the draft, 25 feet 6 inches; with a displacement of 15,450 tons. Eight 12-inch guns are mounted, and the twin-gun barbettes are so arranged that all of the guns may fire on either broadside, while six may fire ahead and six astern. This has been achieved by placing two guns on the port side and two on the starboard side, with a very considerable distance separating the barbettes in the longitudinal line; the only obstruction is one funnel, so that the guns have a very wide arc of training on both beams. The other guns are, of course, mounted in center line barbettes forward and aft. There are also ten 4-inch guns on each broadside, all of them within the side armor of the ship. Four of the 4-inch guns fire ahead and four astern. As regards protection, the main belt is 9 inches thick, while above this is 6-inch armor and a 3-inch upper strake to protect the upper works and to form the 4-inch gun battery. The barbettes are of 10-inch armor. The main belts on the broadside extend right fore and aft, but are reduced forward and aft to 4 inches in thickness. A notable feature is that, almost extending the whole length of the ship, there is on each side, forming the interior wall of the coal bunkers, a fore-and-aft armored bulkhead 1½ inches thick. The boilers are of the Yarrow type, and the turbines of the Parsons' design; these are designed to give a power which, it is anticipated, will drive the ship at a speed of about 20 knots. The vessel, too, has a large radius of action—7500 nautical miles—so that it must be recognized that in her design there has been achieved a most satisfactory compromise of conflicting claims.—*Engineering.*

UNITED STATES.

VESSELS BUILDING.

No.	Name.	Speed. Knots.	Where Building.	% of Completion Mar. 1.	Apr. 1.	May 1.
	Battleships.					
32	Wyoming....	20½	Wm. Cramp & Sons.	93.5	94.9	97.0
33	Arkansas....	20½	N. Y. Shipbuilding Co.	90.9	93.7	96.9
34	New York...	21	Navy Yard, New York.	26.8	30.4	35.3
35	Texas.....	21	N'pt News S. B. Co.	56.1	59.0	61.9
36	Nevada	20.5	Fore River Co.	0.	0.	0.
37	Oklahoma ...	20.5	N. Y. Shipbuilding Co.	0.	.6	.7

THE NEW UNITED STATES BATTLESHIPS "NEVADA" AND "OKLAHOMA."—The navy has every reason to be pleased with the design of our latest battleships, the *Nevada* and *Oklahoma*, contracts for the construction of which have recently been let to the Fall River and the United States Shipbuilding Companies. These ships represent, to a greater degree than any of their predecessors, the united experience and thought of the various branches of the naval service; and the officers of both line and staff unite in the belief that these two ships are the most powerful vessels afloat or under construction to-day. The armor plan is particularly effective and decidedly original, and in a comparison with previous vessels it will be noted that there are some very radical departures from existing practice.

The *Nevada* will be driven by Curtis' turbines and the *Oklahoma* by reciprocating engines. The boilers in both ships will be fired exclusively with oil, and they will carry no coal. The estimated speed is 20½ knots.

The considerations which led to the adoption of the three-gun turret were that, by elevating, training and firing the three guns together, great assistance will be rendered to the spotter in determining the fall of the shots, and he will be able to telephone the corrections with much greater accuracy than he could if the guns were fired separately. The armament will consist of ten 14-inch guns, carried in four turrets, disposed as follows: On the forecastle deck will be first a three-gun turret, then a two-gun turret. On the quarter deck will be a two-gun turret and astern of that a three-gun turret. This arrangement will give a concentration of fire superior to that obtainable from the ten 14-inch guns of the *New York* and *Texas*, which will be mounted in five two-gun turrets.

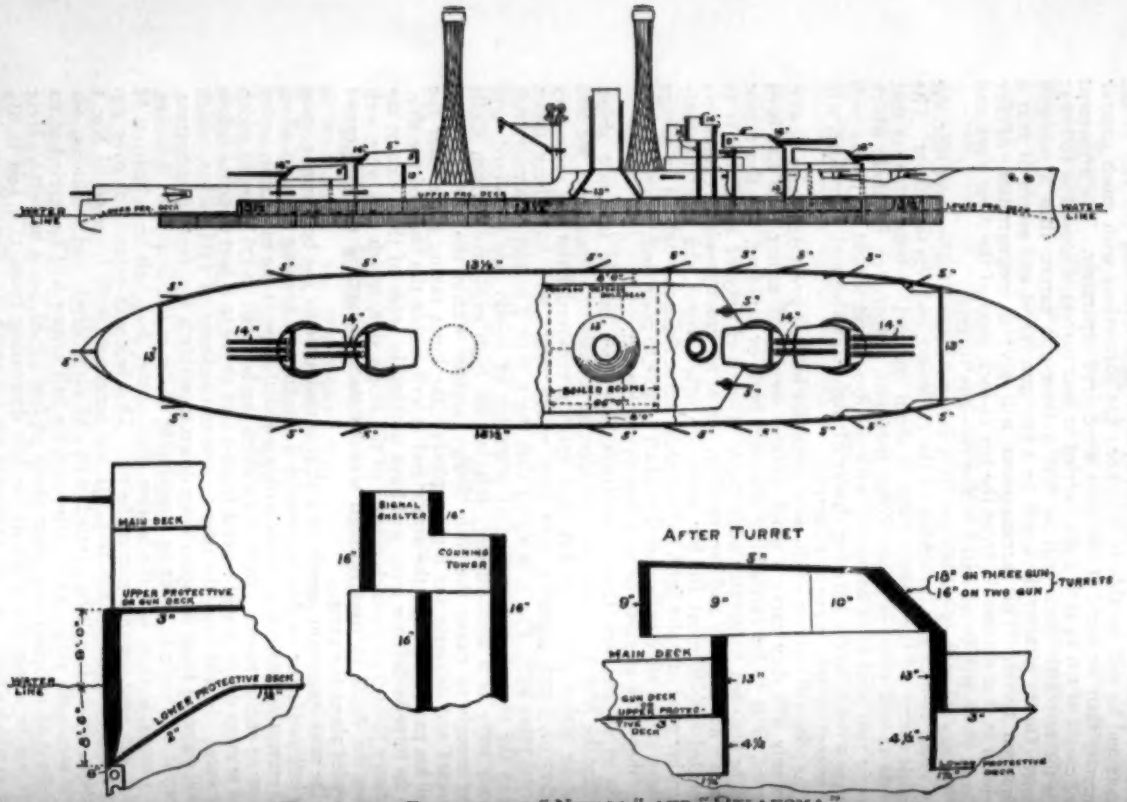
The new 14-inch 45-caliber gun is a far more powerful weapon than the 45-caliber, 12-inch gun, mounted on the *Delaware* and *North Dakota*. The muzzle energy of the 12-inch piece is about 49,000 foot-tons, whereas that of the 14-inch piece is about 66,000 foot-tons. Moreover, its shell, which weighs 1400 pounds as compared with the 870-pound weight of the 12-inch carries a much larger bursting charge of high explosive and, therefore, will be proportionately more destructive.

The principal interest of the new ships lies in their great defensive power. Not only will they carry a much greater weight of armor than has been carried, or is to be carried, by any ship built or building, but the armor will be disposed to greater advantage. The chief duty of a warship is to maintain her stability and her mobility, and at all times present a completely protected emplacement for her guns. In other words, she must not only carry her guns into the fight, but she must nurse them through all its savage hammering, so effectually that they shall be able to pour shell into the enemy until they have silenced or sent him to the bottom.

So let us see how these conditions have been met in our new ships. Taking the *North Dakota*, for instance, as a basis of comparison, we find that the armor protection has been entirely removed from the secondary battery of 5-inch guns—a wise step, which might well have been taken several years ago. For it is a fact that the 5, 6 or 7 inches of armor with which the secondary batteries of warships of to-day are protected, will simply serve as a shell-burster, delaying the high explosive 14-inch shells long enough to cause the little firing hammer within the shell to leap forward and detonate the high explosive, the burst taking place after the shell has passed through the armor and is well within the body of the ship. So the torpedo-defence guns will have nothing in front of them except the ordinary ½-inch or ⅝-inch plating of the ship's side, which may very well allow the shells to pass through without bursting among the gun crews crowded about the guns.

The most important armor on a ship is undoubtedly the belt armor upon the hull itself; for to this is committed the duty of keeping the ship afloat and preventing projectiles from striking a vital blow in the magazine, boiler rooms or engine rooms. In the new ships the belt will be 17½ feet in width and, at mean draft, it will extend from 9 feet above to 8 feet 6 inches below the water. It will have the unprecedented thickness of 13½ inches, which it will maintain from its upper edge down to within a few feet of its bottom, where it will begin to taper to a minimum width at the bottom of 8 inches. Very rarely, if ever, will the bottom edge of this deep belt be rolled out of water, exposing the thin plating below. This belt will extend for over 400 feet along each side of the ship. It will terminate well forward of No. 1 barbette, where it will be carried, with the same depth and thickness, entirely across the ship. At its after end the belt armor will be carried at its full depth of 17½ feet to a point about 30 feet aft of No. 4 barbette. Here there will be a jog, the depth of the belt decreasing from 17½ feet to 8½ feet, at which depth it will be continued aft for another 60 feet. Transverse bulkheads of the same thickness as the belt will here be carried across the ship.

An important feature of the side armor is the manner in which the plating will be laid on the ship. Hitherto the armor has been placed horizontally,



THE ARMOR PLAN OF THE "NEVADA" AND "OKLAHOMA."

Length, 583 feet; beam, 95 feet 9½ inches; draft, 28 feet 6 inches; displacement, 27,500 tons; fuel, oil exclusively; speed, 20½ knots; armament, ten 14-inch guns; torpedo-tubes, four 21-inch; armor belt, 13½ inches; barbettes, 14 inches; conning-tower walls, 16 inches; conning-tower roof, 6 inches; gun-turrets, 18 inches on three-gun turrets and 16 inches on two-gun turrets; protective deck, 3 inches on the flat and 4½ inches on the slopes.

in two strips, with a continuous horizontal joint, located slightly above the water-line, between the upper and lower strip. This had the disadvantage that it presented a continuous line of cleavage, near the water-line, and, therefore, at a most vulnerable point. In the new ships the armor plates are laid vertically, the joints being vertical and the plating extending the whole depth of the belt without any continuous joint at the water-line. This is a most important improvement which will add greatly to the protective power of the side armor. Associated with the heavy belt in the work of protecting the ship's stability are two protective decks—a lower deck 1½ inches thick on the flat which will slope along the sides to a junction with the bottom of the armor plate 8½ feet below the water-line. The slopes of this deck are 2 inches in thickness. On the deck above (the gun-deck) is an upper protective deck, 3 inches in thickness. These two decks provide an excellent protection against plunging fire, and also against fragments of shells which might be exploded in passing through the thin ship's plating in the wake of the gun-deck.

Equally massive is the armor protection for the main gun positions. The barbette armor extends, with a thickness of 13 inches, from the turret down to the upper protective deck, and from the upper to the lower protective deck the thickness is reduced to 4½ inches—this because of the 13-inch protection afforded by the side armor. The turret armor is equally massive. The port plate is 16 inches on the two-gun turrets and 18 inches on the three-gun turrets, and the side and rear armor is 10 and 9 inches in thickness, while the roof carries 5 inches of armor.

The battle of the Sea of Japan showed how important it is to thoroughly protect the positions from which the fighting of the ship is controlled, and particular attention has been given to this in our new design. The conning-tower and the signal station back of it each carry no less than 16 inches of armor, and to protect the communications—telegraph and telephone wires, voice tubes, etc.—the section upon which conning-tower and signal station are supported has walls of 16-inch armor, which are carried down to the protective decks.

It will be noticed that the new ships have but one smokestack—and thereby hangs a tale. The new ships, as already stated, will burn fuel oil exclusively. This has enabled the designer to dispense entirely with coal bunkers—the oil being carried chiefly in the double bottom of the ship. The omission of bunkers sets free a large amount of space below decks, which has enabled the designer to concentrate all of the six boiler compartments at the center of the ship, where they occupy only 65 feet of her length. Hence, it was possible to use a single smokestack, placed immediately above the boiler rooms, and hence, again—and this is the important point—it was found possible to place around the whole of the uptakes a massive redoubt of inclined armor with walls everywhere 13 inches in thickness. This redoubt extends from the upper protective deck to the spar deck, and that portion of the smokestack and uptakes which is within the structure of the ship will be completely protected against perforation. The importance of this construction will be appreciated, when we bear in mind that, in the Japanese War, it was the perforation of the uptakes which contributed largely to the collapse of the Russian ships. The poisonous gases, escaping between decks, were drawn down and disseminated throughout the ship, frequently driving the crew from their quarters.

From the above description it will be evident that in the *Nevada* and *Oklahoma* the United States Navy will possess two fighting ships which will be the equal, if not superior, to any ships in their gun power and which will be greatly superior in their power of endurance in a long-drawn-out fight. If Congress will only be wise enough to add year by year the two battleships which represent the minimum requirement of our navy, we shall be in a position to maintain our standing among the navies of the world. If less than two battleships a year be authorized, our navy will steadily retrograde.—*Scientific American.*

The *Florida's* speed of 22.54 knots has only been nearly equalled by the *Vanguard* (English) with 22.50 knots to her credit.

The *Texas* was launched May 18, 1912, at Camden, N. Y.

THE "HENLEY."—The principal dimensions of the torpedo-boat destroyers *Henley* are as follows: Length between perpendiculars, 289 feet; length over all, 293 feet 10½ inches; breadth moulded, 26 feet 4½ inches; trial displacement, 742 tons; trial draft, 8 feet 4 inches. Battery—five 3-inch guns, three 45-cm. torpedo-tubes on deck, two .30-caliber automatic guns.

The machinery spaces occupy the amidship portion of the destroyer, the installation consisting of four Fore River-Yarrow water-tube boilers. The vessel is fitted with two 18-stage Curtis reversible marine turbines, 63 inches in diameter and capable of developing 5500 S. H. P. each, at about 585 revolutions per minute, which will give the vessel a speed of 29½ knots per hour. For the purpose of bettering the economy of consumption of steam at low speeds there has been fitted at the forward end of each turbine, and connected to it by means of a jaw clutch, a 10½ x 22 x 10 inch stroke vertical, compound, reciprocating engine, which at 16 knots is intended to develop 400 I. H. P. at 280 R. P. M., with a steam pressure of 250 pounds in the high-pressure chest. The steam, after passing through this engine, is put through the turbine and the energy remaining in the steam after passing through the reciprocating engine is extracted down to the last ounce of pressure in the turbine. Shop tests of this unit conducted by the Naval Board last December, showed, according to the report of the Board, that the gain in economy at 16 knots amounted to 33 per cent; at 13 knots, 62.4 per cent, and at 10 knots, 98.96 per cent over the performance of the turbine under similar conditions of steam. The contractors guaranteed that the gain at 16 knots would be 25 per cent. It is expected that the *Henley* will be the most economical torpedo-boat destroyer in the U. S. Navy at all speeeds from 10 knots up to 31.—*The Nautical Gazette.*

It is probable that the new fuel ships authorized by the Naval Appropriation bill now pending in the House Naval Committee will be constructed so that they can be converted into coal or oil carrying vessels. As far as that is concerned all of the fuel ships will be built so that they carry either fluid fuel or coal. This can be done by extra riveting. The *Orion, Jason, Proteus* and *Nereus,* now under construction, will carry both coal and oil. They will have bunkers for 12,500 tons of coal and 900,000 gallons of oil. The fact that the new battleships *Oklahoma* and *Nevada* will be oil burners makes it necessary to provide a larger fluid fuel carrying capacity for the navy's auxiliaries.—*Army and Navy Journal.*

COLLIER "ORION."—This vessel was launched March 23. The *Orion,* while practically a duplicate of the *Neptune,* has many claims for attention. The keel plates were not laid until October 6 of last year, and her launching to-day establishes a new record for American shipyards in the time consumed between laying the keel and the launching of a ship of her size.

She is 514 feet in length between perpendiculars and 536 feet over all; has a molded beam of 65 feet and a depth of 39 feet 6 inches. Her hull is constructed under the Isherwood system of horizontal framing, which until two or three years ago was unknown in this country. The first ship ever built under the Isherwood system was built at the Point and was the *Millinocket* for the A. S. Bull Steamship Company, of New York.

The *Orion* will carry 12,500 tons of coal, which means all that a solid train of coal cars two miles long can handle. Her twin screws will drive her at the rate of 14 knots an hour when loaded. The coal unloading device is the design of the local company and will handle 100 tons an hour from each hatch. In addition to capacity for coal, she is also provided with tanks for fuel oil. Oil may also be carried in the double bottoms under the regular cargo holds.

Two triple expansion engines will develop 7000 horse-power. The diameter of the cylinders will be 27, 46 and 76 inches, respectively, by a 48-inch stroke. Steam will be furnished by three double-ended boilers, each of which is 15 feet 10½ inches in diameter, by 21 feet 2½ inches long, weighing 150 tons and carrying a working pressure of 200 pounds.

These new colliers are among the finest afloat and compare with any in the navies of the European countries. There are accommodations for 25 officers and a crew of 152. The officers' quarters are to be finished in oak, and those for the crew in cypress.

COALING.—Rear-Admiral Osterhaus, commander-in-chief, in a wireless report to the Navy Department on March 18 said that the *North Dakota* had established a record for coaling while under way at sea, having taken aboard 499 tons from the collier *Vulcan* in one hour and averaging 410 tons an hour for four hours.—*Army and Navy Register.*

ORDNANCE AND GUNNERY.

GUNS AND PROJECTILES.

SIZE OF GUNS.—*Le Yacht* considers the 12-inch large enough to penetrate all existing armor, and that the 12-inch heavy shells hold plenty of high explosives to produce terrible destruction. Certain navies have adopted a larger caliber because the metal of the guns was being strained beyond its limit of resistance. The English especially worry over the life of their guns. The firing trials of the *Saint Vincent* class showed deep erosive grooves in the powder chamber and near the muzzle. Therefore, to reduce this, a greater caliber became necessary. 13.7-inch and 14-inch were adopted, and, as foreigners adopted this increase in size the French had to also, though their 12-inch had a very long life. The larger caliber in spite of the smaller initial velocity increases the striking effect especially at long ranges. The 13.7-inch shell will penetrate at 7000 yards the same thickness of armor that a 12-inch will at close range. The former's danger space is greatly increased.

In the battleships of 1913 it is stated that the Italians will readopt the 12-inch caliber. It is alleged that the reason for adopting the 12-inch caliber is that neither the Vickers-Terni works nor the Armstrong factories are at present in a position to supply guns of a larger caliber, and on national and economic grounds it was not thought wise to resort to British or other foreign establishments. Moreover, it is stated that experiences with guns of a heavier caliber, which had come to the knowledge of the Italian authorities, have not encouraged them to adopt anything larger than the 12-inch.—*Army and Navy Gazette.*

Japan has had a 15-inch gun sent out from England and intends to mount such weapons in a battleship to be built in Japan and to be completed by 1915. (Note the Japanese statement to contrary in No. 141.)

Should it be demanded of a gun of a lower caliber firing a lighter projectile at a higher muzzle velocity, or of a larger caliber gun firing a heavier projectile at a lower muzzle velocity? So long as the metal used for the gun, the system followed in the construction of the latter and the powders fired, have not varied to any very great extent, experience has invariably confirmed, up to the present time, the very great advantage to be derived, from every standpoint, by an increase in the gun caliber. The development of naval ordnance shows this at a glance. It is also a well-known fact that the comparative superiority of the larger caliber gun asserts itself in increasing degree as the range at which a naval engagement takes place is augmented.

From the point of view of the artillerist the conclusions are quite clear. He is able, using a 13.5-inch, 14-inch, or 15-inch gun, to supply a residual energy equal, and even superior, to that given by a 12-inch 50-caliber gun, while demanding from the metal forming the gun—and this is most important—an amount of work which decreases directly in proportion as the caliber increases. He is able, therefore, to build guns which not only gradually increase in power, but whose life will also increase. These guns will impart to their projectiles a perforating power at long ranges which will gradually increase with the caliber, and the points of fall will be easier to note. In the second place, the perforating power of the projectiles is decidedly better utilized with the increase in caliber, for the percentage of efficiency of increased caliber is greater than that of increased thickness of plate—a 13.5-inch projectile will more easily perforate 13½-inch armor than will a 12-inch shot attacking a 12-inch plate. In other words, if it is practicable to improve the resisting power of armor by adding to the thickness beyond 12-inch, projectiles fired by the higher caliber guns will be far less handicapped than those fired from the 12-inch gun.

Further, in addition to greater perforating power in the projectiles of the higher calibers, they enable a higher proportional explosive charge to be used. In the opinion of several officers a 12-inch projectile, weighing about 1000 pounds, can contain an explosive charge having approximately 3 per cent its weight, without losing any very great proportion of its perforating power. It is not unreasonable to suppose that a 14-inch shell, weighing, say, 1540 pounds, can, under the same conditions, contain a charge of 3.5 per cent, and a 15-inch shell of 1765 pounds a charge of 4 per cent. This gives for the latter an explosive charge weighing 70 pounds—quite close to that of 75 pounds of non-armor-piercing shell which caused an enormous amount of damage in the late Russo-Japanese War. It is absolutely certain, however, that a 15-inch projectile would be far more dangerous against a modern battleship than any 12-inch projectile containing the 7.5 per cent of explosive charge.—*Engineering.*

DATA OF GUNS.

Caliber.	Nationality.	Projectile.	Charge.	I. V.
11-in./45	German	680	248	2900
12-in./45	British	850	330	2900
12-in./50	U. S.	870	310	2700
12-in./50	British	850	350	3000
12-in./45	German	875	329	3000
14-in./45	German	1400	508	2870
13.5-in./45	British	1250	510	2870
14-in.	Japanese	1869		
13.5-in.	Japanese	1250		

FRENCH HEAVY GUNS.—The 1910 pattern 9.5-inch French gun, built for coast defence, has had to be withdrawn. One of these guns blew out its breech-block at proof in September, 1910; two months later a second burst explosively, the breech portion being blown to pieces; and three more of these guns have since shown signs of weakness. The cause is difficult to discover, since the only point in which this pattern differs materially from earlier designs is in the breech-block, which is a new pattern of stepped screw. It fires a 500-pound shell with charge of 147 pounds of gun-cotton powder, or about the same charge and projectile as our own 10-inch, which is a heavier gun. Possibly the instability of the French powder is again in fault. If so, the French Navy will sooner or later be forced to abandon it in favor of cordite, which, with all its defects, is at least a safe propellant.—*Army and Navy Gazette.*

LIFE OF NAVAL GUNS.—We worry about the small number of rounds per gun which magazines of our battleships hold. The length of a battle limited

by this number of shots will appear very short, and furthermore it is quite likely that the life of the guns, if they are not new, will make a quicker end to the fight than the exhausting of the ammunition supply. Commander Ettore Bravetta, of the Italian Navy, an ordnance expert, gives in an article in the *Rivista Nautica*, the following table:

Caliber.	Rapidity of fire. Seconds. Time between shots.	Maximum number of shots the gun can stand.
12/45	60	100
12/50	60	86
13.3	80	80
14	90	75
16	110-120	65

The rapidity of fire is generally greater than that given above, but it is necessary to consider the actual delays in action. In adopting the foregoing as a base from which to reckon, we see that a ship having an absolutely new armament could not fight longer than one hour and forty minutes with her 12-inch guns, . . . and but a little over two hours with guns of 14 or 16 inches in caliber.

The above table refers to guns using a nitroglycerine powder. In the French service, we consider that 12-inch guns will fire 200 rounds.—*La Vie Maritime.*

AERIAL QUICK-FIRING GUN.—A new quick-firing gun has been produced by Messrs. Vickers for use on dirigibles and aeroplanes. The weapon has been taken to the company's Eskmeals range on the Cumberland coast, where it has been thoroughly and successfully tested. It is of very light construction, is shaped almost like a telescope, and weighs probably not more than 1 cwt. It is easily trained and worked, and is reported to be a weapon which can easily be carried by an aeroplane or airship.—*Page's Weekly.*

DAVIS AEROPLANE GUN.—What is claimed to be the largest aeroplane gun yet made was successfully tested March 20, 1912, on a barge off Fort Wright in the presence of a number of the United States naval and army officers. The gun was fired twice, and although it is mounted on delicate steel springs, there was absolutely no recoil.

The inventor of the gun is Commander Cleland Davis, U. S. N. It is a 4-inch gun, 12 feet long, weight 150 pounds and fires a projectile weighing 33 pounds at a velocity of more than 1000 feet per second. The gun is made of vanadium steel.

Commander Davis and others expressed themselves as extremely well pleased with the test. After a few minor changes have been made, the gun will be shipped to Washington to be officially tested by the government.

A NEW PROJECTILE.—The French coast defence batteries have recently been equipped with a new type of shell for use against armored ships. Ordinary shell with ogival heads ricochet from the surface of water, and any rounds which pitch short of a ship, however close up, are lost. But the P shell, as it is called, has a long conical point with projecting ogival shoulders, and the effect of this particular shape of head is that at long and medium ranges the shell does not ricochet but dives under the water at an angle of 20 degrees to the surface, and, if it falls within 50 meters of the ship, it strikes the unarmored side below the armor belt, and there detonates. The difficulty in designing the shell has been to provide a fuse that will not act on striking the water, but will explode the shell on striking the ship. This difficulty has now, presumably, been overcome, but the details of the fuse are kept secret.—*The Army and Navy Gazette.*

Up to April, 1912, the only nations adopting the 3-gun turrets are Italy, Russia, Austria and the United States.

ARMOR.

SIMPSON PROCESS.—This is used to weld a high-speed steel to a soft steel, or to make armor composed of alternate layers of hard and soft steel. Trials have been made of a plate having two inches of hard steel welded to four inches of soft steel. Results were highly satisfactory. Mr. W. S. Simpson invented this process which is to place two steel plates with a layer of copper between them in a mixture of carbon, brown sugar, and water, of the consistency of compressed snow, and to submit the whole mass to a temperature of 2000° F. The copper melts away into the steel and forms a perfect weld as examination by stress and microscopic tests has proven.

VANADIUM PLATE.—These are used successfully for deck plating up to three inches in thickness and give most remarkable results. The plate is exceedingly tough. In addition to the adoption in United States of this type of plate, Germany and Great Britain are considering it.

FIRE CONTROL.

POSITIONS.—The latest German vessels are not fitted with fire control positions aloft, and we infer that they do not control their fire by observation of fall of shot as in ours and the British navies. So far as experience goes, while a position in a conning-tower with use of periscope is practicable, it is difficult to understand how it can be efficient.

It is reported that the Germans have made wonderful advances with periscopic observations. Their control station is amidships between decks. At this station by means of tubes and prisms all quarters of vision are commanded, and images made on parabolic reflectors. Distances are exactly determined by special contrivances. Supplementary telescopic tubes are fitted on each side of ship having total reflection prisms just above load water-line, and similar prisms at the station end of the tube allow the control officer free vision over a limited area. This system was originated by experimentation with submarines.

The masts used in our navy save weight over that type used in England, but offer a conspicuous target at a long distance. Argentine and Russian ships are fitted with these cage masts, those in the latter navy being of two types. Those of the *Imperator Pavel* class are similar to ours, those on the *Gangoot* class carry the cage construction to height of 77 feet, the fire control top being located there, from which a pole mast, for signalling, rises 66 feet more.

RANGE FINDERS.—The 9-foot base Barr and Stroud, Zeiss or Bausch and Lomb range finders are located in the tops as in the British Navy, and in other navies in armored towers from which a good view of the horizon is obtained. It is claimed that the German range finders mounted in their turrets are marvels of accuracy and for that reason no station aloft is necessary for putting shots on the target. Instruments to correct the range for the relative courses and speeds of the enemy are in use. The instrument of Captain Dumaresq, combined with the Vickers' clock, is used abroad. For transmitting readings electric devices are most commonly used. The French have some pneumatic and hydraulic instruments working on the Bourdon pressure gauge principle. Many navies are working to the end that the sights both range and deflection will be automatically corrected at each individual gun.

Nothing can be learned as to the results obtained on the *Neptune* with the battery arranged so that elevation and train both were in the hands of the fire control officer. These tests were held in March, 1911, and are said to have been encouraging.

TORPEDOES AND MINES.

PROTECTION OF BATTLESHIPS AGAINST MINES AND TORPEDOES.—The various technical journals of the world are now widely discussing this interesting topic.

A brief glance at some of the mine disasters of the Russo-Japanese War shows that the Russians lost the battleships *Petropavlovsk* and the *Pobyeda*, the cruisers *Yenisei* and *Boyarin;* the Japanese, the battleships *Hatsuse* and *Yashima*, and the destroyer *Akatsuki*.

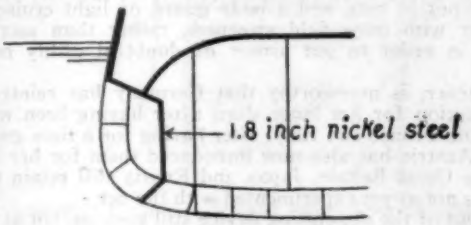
Among the torpedo disasters we note those of February 9, 1904, when the *Pallada*, *Cesarevitch* and *Retvisan* were so badly damaged that they were out of the fleet until July, and that the sinking of the *Alexander III*, *Suvoroff*, *Borodino*, *Siretlana*, *Sissoi Veliki*, *Nakinoff* and *Vladimir Monomach*, at the battle of Tsushima, was due mainly to torpedoes.

The necessity of good protection under water and above against mines and torpedoes is thus very apparent.

The two methods of protection thus far considered are first structural—subdivisions or armor plating the hull—and second, the use of nets.

There seems to be a fairly uniform opinion that one should employ a strengthened longitudinal bulkhead at some distance from the outer skin together with a good system of cellular compartments.

Some known facts regarding under-water protection in modern ships are these (*Journal of Royal United Service Institution*):



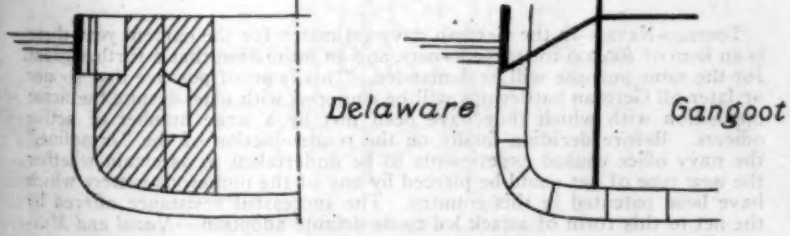
"DANTON."

This French vessel has an interior bulkhead, as shown, comparatively close to the ship's side, and curving in a marked degree at the upper and lower parts until it meets the outer skin. The object of this is conjecture only.

The Brazilian ships *Minas Geraes* type have on either side an internal longitudinal bulkhead 1.5 inches thick at some yards distance from outer skin. This should be the correct practice.

The Argentine ships, *Moreno* class, have similarly a bulkhead 1-inch thick; and, in addition, an inner bottom .7-inch thick at a distance of 13 feet from the outer bottom.

The Russian ships, *Gangoot* class, have only an ordinary longitudinal bulkhead.



Experimentation has established (a) that there is an enormous decrease in explosive effects at an increase of distance from the explosive mass, and we find that the usual charge for a Whitehead torpedo of 220 pounds gives, at a distance of only 59 inches from its surface, but 1/40th of the destructive effect at the surface of the mass; and (b) that under-water explosions are more dangerous *horizontally* and *downward* than vertically and up.

Thus, this most important fact to bear in mind, that an armor plate if used should be placed *not on the outer shell of the ship*, but at *some distance inside*. Thus a plate 59 inches inside the hull is equal in resisting power to one 40 times as thick placed on the outside skin of ship.

Baron Roenne, in the *Journal of the Royal United Service Institution*, proposes a triple bottom. These to be at distances of 33 inches from each other, and the inner to have nickel-steel armor. The space between the bottoms are to be minutely subdivided, and filled with cellulose or some liquid. Naval Constructor S. Nonaka, I. J. N., holds the view that the great weight entailed by this construction is prohibitive; that it would be better to stick to the double bottom only; and also stick to torpedo-nets, and put any extra weight into offensive power.

In the opinion of Mr. Orlando, President of the Italian Institute of Naval Architects, the side of the ship should have little real armor and protection should be placed as near amidships as possible, and the water-tight compartments should be reduced in size.

The water-tight compartments of the double bottom should be filled with corn pith cellulose or other water-excluding material for considerable distances, and trust put in nets, and a body guard of light cruisers and destroyers, together with mine field sweepers, rather than sacrificing gun power or speed in order to put armor of doubtful utility on an inner bottom.

The fact, however, is noteworthy that Germany has reintroduced the torpedo-net protection for her large ships after having been without nets for ten years. Both France and Italy, after having for a time given up nets, now use them. Austria has also now introduced them for her new battleships. Of course Great Britain, Japan and Russia still retain them. The United States has not as yet experimented with the net.

The development of the net-cutting device still goes on, but at present the net is ahead. However, if we include the Davis gun torpedo in our estimate, then the net has possibly met its match already, and net protection must give away to minute subdivision of compartments.

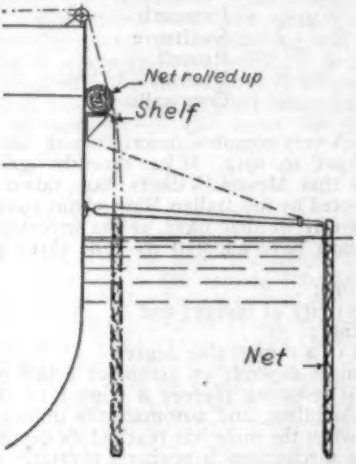
DAVIS TORPEDO.—The *Journal of the Royal United Service Institution* says of this torpedo, that its main defect, the weighting of the head seems to be overcome, but there seems, however, to be no immediate prospect of the introduction of the Davis torpedo in the United States, though its design is based on a sound principle. The reasons for its not being adopted are not known.

The results of the trials of the Davis gun torpedo show that even if stopped by a net it would send its shell through the net, the intervening water, the hull, and a defensive bulkhead right into the vital region.

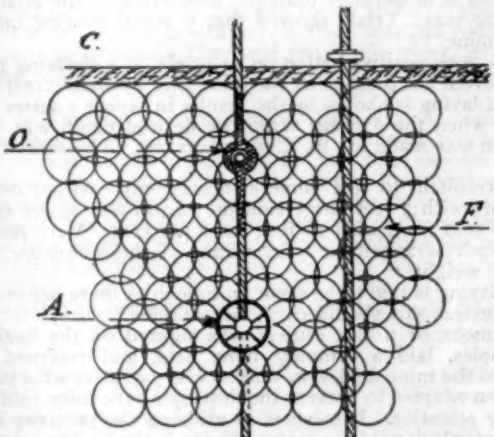
TORPEDO-NETS.—In the German navy estimates for the current year there is an item of £60,000 for torpedo-nets, and an intimation that a further grant for the same purpose will be demanded. This is proof positive that sooner or later all German battleships will be equipped with nets, despite the fierce opposition with which they have been met by a large number of active officers. Before deciding finally on the reintroduction of the "crinoline," the navy office caused experiments to be undertaken to ascertain whether the new type of net could be pierced by any of the numerous cutters which have been patented in this country. The successful resistance offered by the net to this form of attack led to its definite adoption.—*Naval and Military Record.*

TORPEDO-NETS.—The reintroduction of the Bullivant net in the French service has met with general satisfaction. These sketches give an idea of the net, showing the inner and outer one, the junctions in one coming opposite to the openings of the other.

The net protects the vital parts: magazines, engines, boilers. Its depth is about 26 feet. It is supported on each side by 12 booms, each 28 feet long, which fit, when net is rolled up, diagonally close to the hull. The ledge for the net is two feet wide. It is worked by special windlasses.



Full lines show nets in place. Dotted lines show net just before it is rolled up.



A = ring for passage of brail.
C = head bolt rope.
F = net.
O = eye of brail.

The time to place or take in a net is at least two minutes. The installation weighs 60 tons. Its cost is about $40,000.—*Moniteur de la Flotte.*

TIME OF HANDLING NETS.—As illustrative of the time required to handle torpedo-nets, the following times in drills in the English Navy at Vigo on March 21, 1912, are given:

Out nets. M.	S.	Battleship.	In nets. M.	S.
2	17	Exmouth	2	5
0	31	Swiftsure	2	7
1	30	Russell	2	7
0	52	Duncan	1	50
2	10	Cornwallis	2	0

THE ELIA MINE.—A very complete description of this mine is to be found in *Engineering* of April 19, 1912. It has recently again come into prominence from the fact that Messrs. Vickers have taken up its exploitation. This system was adopted by the Italian Navy about 1900. Captain Giovanni Emanuele Elia, formerly of that navy, is the inventor. The Dutch, Belgians, and Roumanians have adopted it. The three essentials of a successful mine:

1. Safety in handling;
2. Precision and celerity of laying; and
3. Efficiency in action;

appear accomplished to a remarkable degree.

One firing mechanism depends on action of a ball put in motion when mine is inclined, and releasing thereby a trigger of the firing pin. This ball is locked while handling, and automatically unlocked by a hydrostatic piston arrangement when the mine has reached its depth. Exhaustive trials prove that the firing mechanism is positive, perfectly safe to handle, and thoroughly efficient.

A contact lever system is used where the rise and fall of tide is great to overcome the inherent faults of the hydrostatic device in such waters. This mechanism is inoperative until the immersion of the mine has melted a sal-ammoniac seal. Trials showed that a vessel moving only one knot exploded the mine.

Twin mines, with positive action on principle of a shearing pin, are constructed to prevent the passage of the mine field by small craft.

Precision of laying is shown by the results in laying a series of 63 mines in July, 1911, when the average from the desired depth was but .43 feet. The immersion was made for 10, 3, 16 and 26 feet. The severity of the test is evident.

The worst result in 10 feet immersion was only 6.66 per cent in excess of that desired; with 3 feet immersion the excess was 20 per cent; with 26 feet but 4 per cent; and with 16 feet but 6 per cent. Very remarkable results. The depth arrangement is by means of the automatic anchor, distance line, and weight.

Celerity of laying is said to be great, inasmuch as there are no firing wires or electrical devices this should easily be obtained.

After the smoke of a fast cruiser was sighted on the horizon a mine layer left Naples, laid a complete mine field, and returned before the cruiser reached the mine field, *i. e.*, a mine every quarter of a minute.

The provision adapted to prevent the destroying the mine field by countermining is very scientific. It consists in utilizing the pressure in the water caused by the explosion of a countermine to lock the firing mechanism of the mine until pressure corresponding to depth of immersion again obtains.

FRENCH MINES.—W. H. B.—The French Navy has adopted a most efficient system of mine defences for the harbors of Toulon and Marseilles. The Harlé mine is claimed, after long experiments, to be far superior to those of any other type. These mines are arranged in groups of ten with a common anchor and cables instead of being moored singly. In the group of ten mines each mine is moored automatically 60 meters from every other mine, and they can readily be laid out to form a barrier in very little time.

In the main ship channels they have groups of 50 mines with a 3000 meter long cable. The mines are exploded by mechanical contact. For sea mine defence of a fleet they have adopted a peculiar simple form of mine defence, that consists of a hose of large diameter filled in sections with an explosive that is ignited by water. The mine hose is laid out and being bouyant can be made to float at a fixed depth below the surface as a barrier any distance from the fleet. The enemy on approaching will be enveloped by the hose, water will flow in where the hose will have been ruptured by being torn from its moorings, and the explosion will damage the ship more or less seriously, and will, it is expected, at least cause leaks by starting seams or other strains.—*Internationale Revue ueber die gessamte Armee und Flotten.*

POWDER.

INSPECTION OF POWDER FOR THE FRENCH SERVICE.—In January the French Navy and Army introduced a systematized powder inspection approximating our own very closely. The army and navy will jointly inspect and thus control in the factories, in the central laboratory, in the research laboratory at Sevran, and will also have a central office in Paris. Factories at Pont-de-Buis, Moulin-Blanc, Saint-Médard, Angoulême, Sevran-Livry will have an officer at each. The control of Saint Chamas will be assigned to the inspector in charge of the Toulon magazines.

The sub-inspector service will be 5 men at Pont-de-Buis, 5 at Saint-Médard, 3 at Moulin-Blanc, 3 at Angoulême, 3 at Sevran-Livry.

The laboratory at Sevran will include a director of the work of testing of samples, an inspector, a clerk, and a variable number of assistants. The research laboratory will have an expert head chemist, an ordnance officer, a chemist, and aids. The central office at Paris will have a director, an inspector of manufacture, a navy lieutenant, and a sub-inspector.

The lieutenants detailed for this duty will have a preliminary instruction for three months during which they will reside at Paris, and will learn the practical part in the central laboratory, in the Versailles commission and at the Sevran proving ground. They will follow the manufacture of powder at Sevran and will spend at least ten days there.—*Moniteur de la Flotte.*

STABILITY OF FRENCH POWDER.—Daniel Berthelot, a celebrated chemist, has declared that "Powder B is the best of the war powders actually in existence." This statement he bases on the fact that, exposed to ultra-violet rays, all samples of the other types of powders decomposed more rapidly than the sample of powder B. Laboratory tests, however, are usually on such a small scale that too much reliance should not be placed on the above result. *One* bad grain in the sample would indicate the end of the test quickly, and such small samples do not represent the whole, by any means, and it is therefore possible that the samples of the other powders may have possessed unstable grains, while, by chance, the B sample did not.—*Moniteur de la Flotte.*

EXAMINING FRENCH POWDERS.—At Toulon parties of seamen have been daily engaged, under the direction of a gunnery lieutenant from headquarters, in clearing out the magazines and powder stores, examining their contents, and destroying all powder which fails to meet the tests imposed by the experts. No powder is now allowed to be embarked concerning which there is the slightest suspicion. Some of the ammunition boxes when opened are reported to have contained the strangest ingredients in the way of packing—worn-out powder bags, with grains of black powder still adhering to them, greasy rags, socks, and even an old hat are mentioned! It has been found necessary to alter the method of closing up the ammunition boxes, as their inspection has revealed that drops of acid, caused by the process of soldering down the lids, have found their way into the interior.

The exhaustive tests which have been carried out show that the process of deterioration begins in the center of a grain of powder, and extends gradually to its outside, so that the previous perfunctory examinations have been more or less worthless. It is even suggested that the trouble may eventually be traced to the presence of a microbe, and the Pasteur Institute has been furnished with a number of samples in order to solve the problem. The condemned powder is strewn in a line over a piece of waste ground adjoining the arsenal, a few boxes at a time, and is then ignited. It burns with a long red flame, and the heat is said to be so intense as to be almost unbearable at 20 yards distance. An immense amount of untrustworthy ammunition has been destroyed in this way, and though the "economists" with whom France is also blessed may complain at this sacrifice of costly material, it is unquestionably a cheaper method than to risk another *Liberté* affair.—*Naval and Military Record.*

The 24 cm. charges of the guns of the *Danton* class are all being reworked in the laboratory because during the trial practice deviations from the prescribed weights were revealed. New methods of packing the charges were introduced. All the powder on board ships that was received from the Pont-du-Buis works is subjected to a rigid inspection once every week. No powder can be accepted on board until one per cent of the amount is inspected thoroughly and found to be perfect. They found one charge for a 24-cm. gun on board the *Danton* that gave signs of deterioration.—*Marine Rundschau.*

TARGET PRACTICE.

GERMANY.—German battle practice for 1909-10 figures. The *Hanover* is stated to have scored 18 hits out of 20 rounds from her 11-inch guns, the *Deutschland* is said to have made 12 consecutive hits with her big guns, and the *Schlesien* is credited with 49 hits out of 60 rounds with her secondary armament. Presumably these examples of good gunnery were high above the general average, and it is admitted that the range did not exceed 6000 yards. The truth is that no reliable information about German gunnery is made public, and while the above figures may be approximately correct it is useless to record the performances of a few picked ships.—*Naval and Military Record.*

GREAT BRITAIN.—The Admiralty have just issued the record of results of the gun practice in the navy in 1911, and these must be pronounced as most satisfactory, indicating a high efficiency not only of "the man behind the gun," but also of the ordnance machinery on board. Last year there were a greater number of ships participating in the gunnery tests than for seven or eight years past, the total being 127, as compared with 117 in the three preceding years, consequently a larger number of guns were fired, the total being 1496, as compared with 1318 in the previous year. This number of guns, indeed, is the highest used in the gun tests for the years embraced in the official returns. With these guns 8228 rounds were fired in the tests, and fully half of these were hits. The conditions this year were again altered; ricochets were only counted as three-tenths of a hit, and under these conditions the percentage of hits to rounds fired was 50.01. If the ricochets made last year had been reckoned as whole hits, as was the case in the previous years, the rate would have been 54.86 per cent, which compares with 51.85 per cent in the previous year, 54.12 per cent in 1909, 53.57 per cent in 1908, and 42.70 per cent in 1907. This last was the year when the targets were reduced in size, and the ship's speed, when firing, was increased. But since then the conditions have been made more onerous, because there is now no choice given to the various fleets as to when the battle practice is to take place, so that in some cases the trials have been carried out in unfavorable weather.

The average rate of hits per gun per minute for the 12-inch and 10-inch guns, including all ships of the fleet, is 0.58. The best performance of any

ship for the 12-inch guns was 2.31 hits per minute, by the battleship *Russell*, in the Mediterranean fleet. The next ship is the *Queen*, with 2.07 hits per minute; the *Britannia* coming third with 2.04; then follow the *Venerable* and *Implacable*. The first *Dreadnought* on the list is sixth, the *Superb*, with a record of 1.76 hits. This must be reckoned as a good result. In other words, within the given time, 17 direct hits were recorded, in addition to four ricochets; whereas the first two ships on the list, the *Russell* and the *Queen*, fired together 31 shots, resulting in 16 hits and two ricochets. The seventh on the list is the *Neptune*, also a *Dreadnought*, which has 1.71 hits per minute.

The best performance for the 10-inch breech-loading gun was 1.67 hits per minute, while in the case of the various types of 9.2-inch guns the hits per minute were 3.34, 4.19 and 2.53, while the average for the whole fleet was 1.90. It would appear, therefore, that, on an average performance, the rate of fire of the 9.2-inch gun on last year's showing is three times greater than that of the 12-inch gun; but this is probably accounted for by the rule that the larger number of 12-inch guns fired, as compared with 9.2-inch guns, tends to bring down the average. The best performances of the guns of the two calibers indicate that the 12-inch gun may be equal to something like 60 or 70 per cent of the rapidity of fire of the 9.2-inch gun. The 7.5-inch gun achieved a rapidity of hits per minute of 5.53 in the best ship, and of 2.78 on an average.

There are various marks of 6-inch gun in use; the average performance for all of these marks in all ships is 3.89 hits per minute. In the latest gun, of the breech-loading type, the best attained was 6.33, in one of the new *Town* class of cruisers, the *Glasgow*. The earlier mark was equally satisfactory, and showed a greater uniformity. With a 6-inch quick-firer, one of the China ships—the *Flora*—achieved 6.82 hits per minute. The results in other ships range down to 1.50; no doubt there is some explanation why one ship should only attain 20 per cent of the hits achieved by another ship of practically the same class. The *Flora* also achieved first place with her 4.7-inch guns, the rate of hits being 5.88 per minute. In the case of the 4-inch gun the best performance is 7.43 hits. It is notable, too, that the battle-cruisers that were fitted with this gun as a torpedo-boat repeller have all come out well, the *Inflexible* having got 7.30, the *Invincible* 6.75, and the *Indomitable* 5.35 hits per minute.—*Engineering.*

In the British Navy too much latitude is given to our admirals and captains in the matter of weather. Occasionally a ship may carry out her practice in a seaway, but we believe this to be exceptional. Fine weather is naturally chosen because the Admiralty are known to attach much importance to the results of these annual competitions. Every captain desires that his gunners shall acquit themselves with credit, while the promotion of gunnery lieutenants hangs upon the results of battle practice. The superior shooting of our gunners on the Australia and China stations is mainly due to atmospheric conditions. On all stations there should be gunnery practice both in fine and bad weather.—*Naval and Military Record.*

MARINE ENGINEERING.

COLLIER "NEPTUNE."—In July, 1911, the United States collier *Neptune*, after having undergone her official speed trials, was temporarily taken over by the government, subject however, to the subsequent fulfillment of contract requirements.

According to contract, an average speed of 14 knots was to be maintained on a continuous 48-hour trial, and the coal consumption for all purposes was not to exceed 1.8 pounds per indicated horse-power per hour, figured on the power developed by the main engines. At the trials referred to the average speed obtained was 12.926 knots, the collective brake horse-power of turbines 5409, or the equivalent indicated horse-power 5879, and the coal consumption 1.791 pounds per indicated horse-power per hour.

The unsatisfactory results were attributed mainly to very inefficient screw propellers, and possibly to inadequacy of the turbines. It will be recalled in this connection that the ship in question is fitted with a mechanical reduction gear, as finally adopted by the Westinghouse Machine Company, operating in conjunction with a new type of Westinghouse marine steam turbine. As a preliminary step, with a view to remedying the failure in fulfilling the requirements, it was decided to make new screw propellers, which were laid down by the Bureau of Steam Engineering, Navy Department, from a design directed by Captain C. W. Dyson, U. S. N. In the trials performed recently with the new propellers the results obtained were most satisfactory, both as to speed and coal consumption. The principal differences between old and new propellers will be found in the comparison appended below:

	Old Propellers	New Propellers
Type	Built Up	Solid
Number of blades	4	3
Diameter	14 ft. 6 in.	14 ft. 8 in.
Pitch	12 ft. 6 in.	12 ft. 1 in.
Projected blade area	61 sq. ft.	50.68 sq. ft.
Trial results	Old Propellers	New Propellers
Speed	12.926 knots	14 knots
Revolutions per minute	119.5	131.7
Coal consumption per I. H. P. per hour, turbines only	1.791 lbs.	1.63 lbs.
Shaft horse-power	5,409	5,980

Maximum speed attained with new propellers was 14.24 knots, with a corresponding shaft horse-power of 6310. The propulsive efficiency figures out about 65.6 per cent. The higher number of revolutions per minute with the propellers aided materially in enhancing the steam economy of the turbines, and therefore a reduction in coal per horse-power.—*International Marine Engineering.*

INSTALLATIONS OF RECIPROCATING ENGINES AND TURBINES.—The installation of the destroyer *Henley*, launched on April 3, 1912, comprises a 63-inch, 18-stage Curtis marine turbine, to the forward end of which is connected, by means of a clutch, a compound reciprocating engine. This installation was tested in December, 1911, at the Fore River Works, and showed the following improvement:

Per cent Improvement of Combination over Turbine.

Actual.	Corrected to 28.5" Vacuum.	Corrected to Same Vacuum and Steam Cond.	
....	....	....	Turbine—10 knots
48.1	48.9	49.9	Combination
....	....	....	Turbine—13 knots
38.3	37.2	39.9	Combination
....	....	....	Turbine—16 knots
26.0	24.7	24.8	Combination—Some live steam in turbine
34.6	34.2	....	Compound—all steam in engine

—*International Marine Engineering.*

England is building a twin-screw destroyer driven by turbines for high speeds, and by internal combustion engines at cruising speeds.

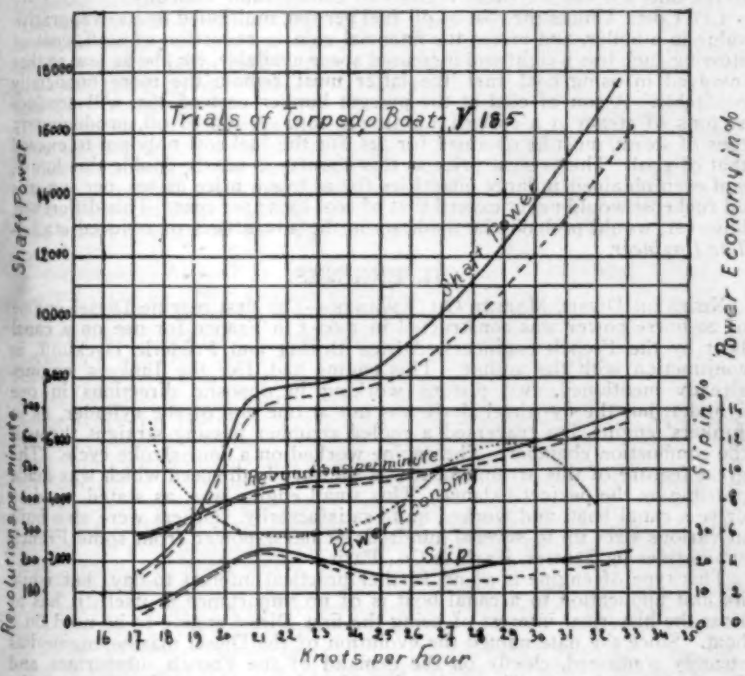
SUPERHEATED STEAM.—The saving by its use is about 8 to 10 per cent in fuel consumption, and 10 to 12 per cent in steam consumption, a superheated

temperature of 100° F. being used. The usual objections, need of oil for internal lubrication, and likelihood of burning the superheater when passage of steam through it is suddenly reduced, are now overcome, the former by use of turbines, and the latter by the Yarrow superheater. The trials of the destroyer, H. M. S. *Archer*, fitted with the above installation, showed the saving indicated above.

PROPELLERS WITH FIXED BLADES IN REAR.—Trials have been made with these in Germany, with the torpedo-boat *V-185*. Great care was taken in the trials, and the chart herewith shows the result.

V-185 is a destroyer, twin screws, with horse-power of 16,000.

The full lines indicate the results with the fixed vanes or directrix, the dotted without.



At the high speeds the benefit of the fixed blades is very marked. It represents nearly 2000 horse-power at 32 knots.

OIL FUEL.—Two-thirds of the world's present oil supply comes from the United States, the majority being Californian, Russia supplies 24 per cent, the remaining 10 per cent being very widely distributed over about fifteen different countries. The total production of oil in 1905, the year when oil fuel alone was adopted for certain of H. M. ships, was about 37,000,000 tons; in 1911 it was nearly 53,000,000 tons. For United States oil fuel, as used in Europe, a calorific value of 19,400 B. Th. U.'s per pound is a fair average, giving an equivalent evaporation from and at 212° F. of 20.1 pounds of water. The cost in England is now about one-half of what it was five years ago. The tendency for the sources of supply to increase is still accompanied by a slight reduction in cost per ton.

The two principal objections to the use of oil fuel are:

(1) Uncertainty of supply. The United States is in a very strong position in regard to oil fuel, and the decision of the United States Navy Department to instal an oil-burning system only in their last two battleships is very significant; the potential advantages of doing so are greater for them than for anyone else. Oil-burning European liners would require to take in fuel on the American side, and the certainty of being able to do so is perhaps rather doubtful, compared with the United States Navy supply. A number of large fast liners burning oil would make a serious inroad into the world's production as it stands at present. For instance, ten large Atlantic liners, each burning 40 tons per hour on fifteen round trips a year of 120 hours each way, would require 3 per cent of the world's present output. The question of the site and cost of storage plant in close proximity to the liner's docks are other matters of considerable difficulty.

(2) Cost. Unless the cost of oil fuel per ton, multiplied by its evaporative value in a boiler, and minus the financial gain in reduction of staff, cost of stowing fuel, less weight and increased space available, etc., be as low as that involved in using coal fuel, the latter must remain the more financially profitable. A ton of coal at the present bunker cost of 16s. will produce 11 tons of steam at a cost of 1.453s. per ton. A ton of oil, producing 15 tons of steam, must be obtained for 22s. for the fuel cost only not to exceed that of coal. The present price in this country is nearly double this figure, and even obtained in large quantities for as low a price as 30s. per ton, the oil fuel cost would never exceed that of coal by 33 per cent. This difference, however, would probably be made up in the advantages of reduced staff.—*The Engineer.*

OIL ENGINES.

NOTES ON DIESEL MARINE OIL ENGINES.—The first marine Diesel engine of 20 horse-power was constructed in 1902-3 in France for use on a canal boat by the French engineers, Adrien Bochet and Frédéric Dyckhoff, in conjunction with the author. This engine had, like the Junkers' engines already mentioned, two pistons working in opposite directions in one cylinder, but the fly-wheel shaft was not at one end of the cylinder, as in Junkers' engine, but traversed a cooled chamber passing straight through the combustion chamber. The engine worked on a four-stroke cycle. The great feature of this arrangement was the very high speed which was made possible by the perfect balance. This small engine was, as stated, used to drive a canal boat, and worked quite satisfactorily. Others were also built in various sizes up to several hundreds of horse-power from some French submarines by Sautter, Harlé & Co., Paris.

This type of engine is of no further practical interest to-day; but while its first application to a canal boat is of no importance in itself, it has at least the historical interest of being the first Diesel engine to be used on a boat. Since the date named the evolution of the Diesel marine engine has steadily continued, chiefly on the demand of the French submarines and Russian river boats. The author has already mentioned that later on the high-speed four-stroke cycle engines, built for electric power stations, were made even lighter than before, and used for French submarines and for Russian river vessels. These engines were not originally reversible; on the contrary, they were used to generate electricity, by means of which the propellers were driven indirectly for maneuvering. In the most favorable case (Delproposto) the propulsion of the vessel was performed directly by the engine, whilst the maneuvering and slow driving were done by means of electricity.

The first reversing marine two-stroke cycle Diesel engine was built in 1905 by Sulzer Brothers, at Winterthur; it was exhibited in 1906 at Milan, and fiitted to a vessel on Lake Geneva in the same year. At that time engineers were not quite clear as to the importance and value of the two-stroke cycle principle, and many firms went on trying for years to make the four-stroke cycle engine reversible. The first engine of this kind was

built by Nobel Brothers, at St. Petersburg, in the year 1908, and was fitted to a Russian submarine.

In many factories reversible four-stroke cycle marine engines are still built, but, on the whole, engineers are, for navigation purposes, inclined to abandon the four-stroke cycle engine entirely and to replace it by the two-stroke cycle engine.

The small four-cylinder engine of 30 horse-power and 600 revolutions per minute is also a reversible four-stroke cycle engine. It was built for experimental purposes in the year 1909, after designs by the author, as an automobile engine for heavy loads, but it can also easily work as a marine engine. The cam shaft is mounted on the cylinder cover.

It is generally known, however, that in the Nürnberg works of the M. A. N. important experiments with large double-acting two-stroke cycle engines are being carried out.

In these works prolonged official tests of a three-cylinder double-acting two-cycle engine of 850 horse-power were made in August, 1911, and the results proved highly satisfactory. At the present time a double-acting two-cycle three-cylinder engine of 2000 horse-power per cylinder is being tested at Nürnberg.

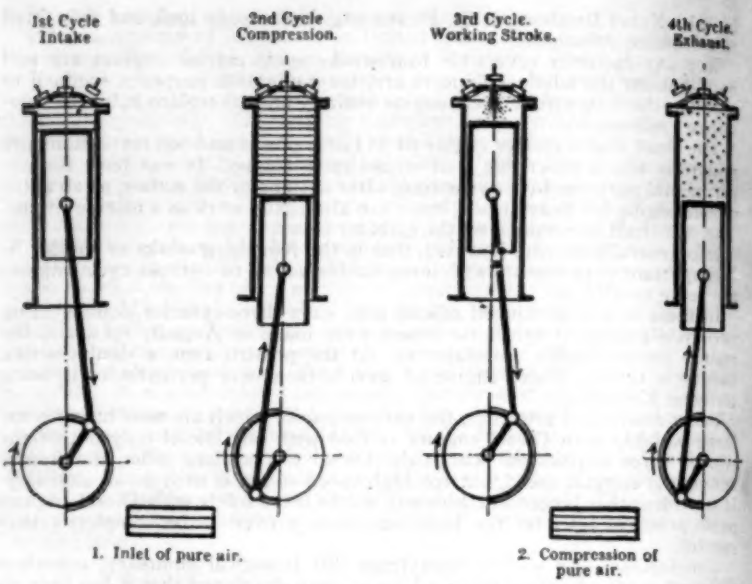
From motives of prudence, the various navies which are now fitting some large warship with Diesel engines started with one Diesel only out of the two or three engines on board; the Diesel works alone when the ship is running at normal speed, but for high speed steam is used as an auxiliary. It is evident that larger warships will not be fitted solely with Diesel engines until practical tests on the high seas have proved to be completely successful.

Conclusions.—As will be seen from this historical summary, countless different types of Diesel engines have so been developed that it has become very difficult for even the expert to choose between them. If one looks through the technical press, numerous other schemes will be found on which the author will not dwell, as they have never been actually carried out. To-day, if a new firm is about to manufacture Diesel engines, it is almost impossible to give them sound advice as to the type and size they should choose from this bewildering variety. The fads, habits, and tastes of the purchasers, and the kinds of machine tools in use in the works, have to be taken into consideration rather than technical points of the engine itself. Development is proceeding so rapidly at present that within a few months opinions even on important points may easily be changed.

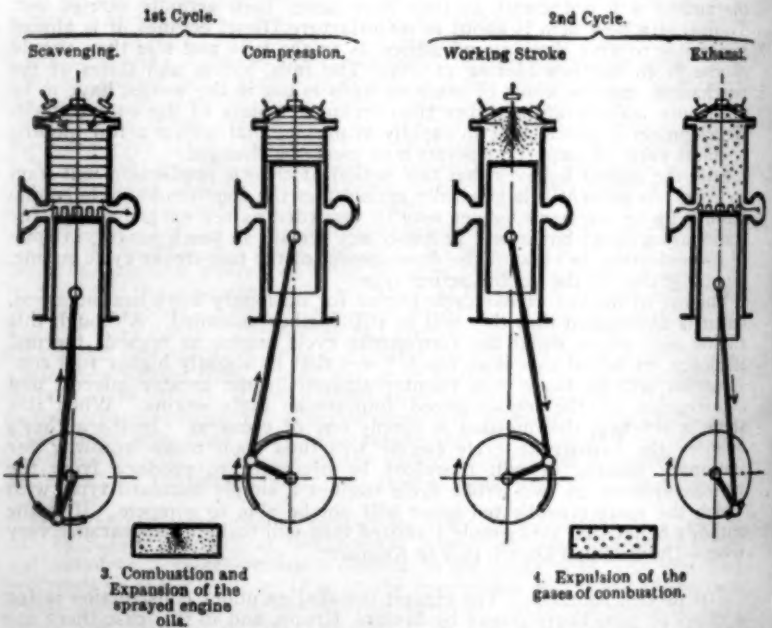
Still, the author believes that this period of chaotic production will soon be over. At present it is generally agreed that the four-stroke cycle engine from 5 up to 600 horse-power may be regarded as the exclusive type for stationary plants; but it will probably not remain so much longer, in spite of its perfection, in view of the development of the two-stroke cycle engine, especially that of the double-acting type.

The use of the two-stroke cycle engine for stationary work has increased, but it is anticipated that this will be still further extended. Although this engine may never equal the four-stroke cycle engine as regards thermal efficiency, its initial cost is so much lower that its slightly higher fuel consumption will be more than counterbalanced by the greater interest and amortisation on the higher-priced four-stroke cycle engine. When this stage is reached, the question is simply one of economy. In the author's opinion, the two-stroke cycle engine will thus soon make headway for stationary plants. It will therefore be necessary to produce from the various systems of two-stroke cycle engines a simple standard type, with which the more complicated types will not be able to compete. It is the author's belief that this simple standard type will make its appearance very soon.—Dr. Rudolph Diesel, in *The Engineer*.

SIZE OF OIL ENGINES.—The biggest installation under construction is for a vessel of 3500 horse-power by Messrs. Krupp, and in this case there are 12 two-stroke cycle cylinders of 22.45-inch diameter, and stroke of 39.4



SINGLE-ACTING DIESEL ENGINE, FOUR-STROKE CYCLE.

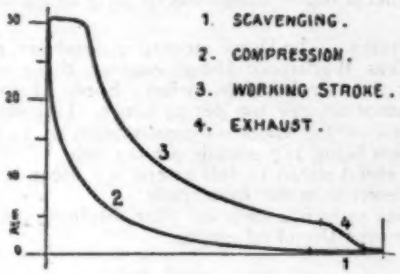


Consult PROCEEDINGS, No. **140**, pp. 1467 to 1474, for principles of oil engines.

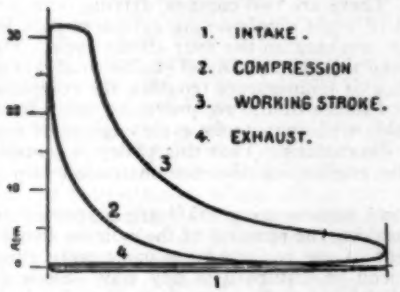
inches. One is in contemplation of 6000 horse-power with 24 four-stroke cycle cylinders of 24.8-inch diameter and stroke of 31.5 inches.

Cargo boats fitted with Diesel motors of 800 to 1000 horse-power have given excellent results and the 2500 horse-power installation on the Danish ship *Selandia*, which has just begun service, is said to have answered all expectations during the recent trials. When, however, we come to installations of 12,000 to 15,000 horse-power for high-speed warships, the conditions are quite different. The Krupps obtained some time ago an order from the German Navy for Diesel motors of high power and so far experiments with these engines have resulted in two explosions, the second one killing eight men and wounding eight more. Diesel motors would solve

Two-stroke Cycle.



Four-stroke Cycle.



INDICATOR DIAGRAMS OF SINGLE-ACTING DIESEL ENGINES.

one of the most delicate naval engineering problems by allowing an enormous saving in weight, besides their great economy in fuel consumption, which would also reduce the bunker capacity for a given radius of action. However, the last catastrophe has revealed the dangerous character of these engines at such enormous pressures as would be required on battleships and cruisers and it seems as if many years would elapse before their employment became practical even in high-speed passenger liners.—*Shipping*, Illustrated.

Two Russian cruisers, each 266 feet 8 inches long by 42 feet 2 inches beam, of about 3500 tons net and 1200 horse-power, have been fitted with Diesel engines by one of the leading marine engine builders in that country. This firm has also furnished Diesel engines for five 1000-horse-

power gunboats, one 900-horse-power gunboat, one 750-horse-power government inspection ship, together with other craft, which brings the total up to 90 ships aggregating 20,000 horse-power.—*International Marine Engineering.*

OUR FIRST DIESEL-ENGINE SUBMARINES.—Our two latest submarines, *E-1* and *E-2*, have two features of novelty, namely, that the motive power consists of Diesel engines, of 520 horse-power, and that the vessels are fitted with a form of folding masts, which reach 30 feet above the deck and will form part of a wireless outfit. The vessels are 135 feet long and each carries four torpedo-tubes. As 5000 gallons of fuel oil can be stored, the vessels will have a wide radius of action.—*Scientific American.*

For submarines the oil engine possesses the advantages, that it is reversible, and that the fuel is not so dangerous to carry as gasolene.

OIL ENGINED VESSELS.—The Dutch steamship *Sembilan*, of 152 feet length, beam of 26 feet, has Werkspoor-Diesel engines, three cylinders, each 12 inches in diameter with stroke of 20 inches. Speed of 200 revolutions per minute. Oil consumption, one ton per 24 hours. Has made a run of 1780 miles at mean speed of 7½ knots on consumption of 14 tons of oil. The average consumption being 11.7 pounds per sea mile.

Time from full speed ahead to full astern is 7 seconds, the engine itself reversing. This vessel is in the Java trade.

The *Vulcanus* has proven a success. Her displacement being 1900 tons, with a 500 horse-power Diesel oil engine.

OIL-ENGINED SHIP "SELANDIA."—This is the first sea-going passenger vessel fitted with Diesel engines, 2500 horse-power, and is for the East Asiatic Company. There are two engines, driving twin screws, each engine consisting of a set of eight single-acting cylinders 20⅞ inches in diameter by 28¾-inch stroke, working on the four-stroke cycle. Messrs. Burmeister & Wain have adopted this type of Diesel engine to obtain greater reliability, owing to the absence of temperature troubles, the completeness of scavenging, and the better balance of the reciprocating parts than has so far been considered obtainable with two-stroke cycle engines of equal power and of the same cylinder dimensions. That this policy is justified was proved by the running of the engines on the demonstration trip from London to Antwerp.

The cam shaft and maneuvering shaft are supported on brackets bolted to the crank case, making the removal of the cylinder heads for the examination and adjustment of the reciprocating parts quite simple, as neither of these two shafts need be disturbed in any way. Skew gearing—the most general method of drive for the cam shaft—has in this design been displaced by cast-steel spur wheels, although it is retained for the maneuvering shaft, which is only in action to bring the opposite motion cams into play, to lift the rollers with their push rods and to replace them. The skew gearing is operated by a compressed-air motor taking air from the starting air reservoirs. There are two fuel pumps for each set of eight cylinders, each pump being of sufficient capacity to supply the whole engine, and, according to the gauge, the pressure of the oil on the exit from the pump was 1000 pounds per square inch. This gives an indication of the extreme accuracy of machining and fitting which is essential for this work.

A fourth-stage compressor in the forward end of each main engine receives the air from the 300-pound compressor, and compresses it up to the pressure required for the injection and pulverization of the fuel—*i. e.*, 900 pounds per square inch. Each one of these high-pressure compressors is equal to the total work of both engines, and, further, an additional length of working stroke can be given to either when it is desired to increase the

output of 900 pounds per square inch air for the recharging of bottles, etc. It is also further possible to fit a delivery valve with connections to a working cylinder in place of the exhaust valve, so as to augment further the store of the starting medium, by utilizing the compression stroke of the cylinder. The engine turns well, and without appreciable loss of balance when firing in seven or even six of the cylinders of one engine. As a final stand-by, a steam-driven three-stage 900-pound per square inch air compressor is installed forward of the oil-fired donkey boiler which is placed aft in the engine room between the thrust shafts.

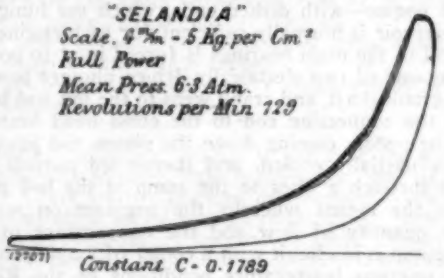
The fuel injection air is stored in two working bottles of German manufacture, with solid ends welded in by a patent process, placed vertically amidships between the compressed-air maneuvering engines. Drain pipes to the bottom of the working bottles are fitted, and periodic blowing down ensures freedom from moisture, with its consequent corrosion. Two spare bottles are placed against the forward bulkhead, and it is so arranged that connections can be made between the independent fuel injectors, one working and two spare air bottles, to keep the main engines running should their air supply fail, due to leakage, etc. It is interesting to note that both the auxiliary Diesel engines have also a fourth-stage air compressor (300 pounds to 900 pounds per square inch) on the forward end of their crank shafts. The starting air, at 300 pounds per square inch, is stored in four reservoirs —two for each engine—with dished ends, which are hung from the deck above. One reservoir is normally sufficient for each engine.

Lubrication oil to the main bearings is forced in at 10 pounds per square inch pressure by one of two electrically driven plunger pumps through the main bearings, crank shaft, and crank webs to the pin and bottom end bearing, thence up the connecting rod to the cross head bearing and up the piston rod to the piston, coming down the piston rod again to the guides, when the oil is partially cooled, and thence led outside the crank case and discharged through a filter to the sump in the bed plate. This discharge supplies the means whereby the engineer on watch can assure himself of the quantity of flow and the temperature of the oil. Each lubricating oil pump is in circuit with a cooler of ample proportions to cope fully with the onerous temperature conditions of the Red Sea and the tropics. There are two cooling-water centrifugal pumps, electrically driven, to supply all the cooling for the main and auxiliary engines, main and auxiliary compressors, lubricating oil, etc.; two duplicate electrically driven three-throw plunger pumps, one for sanitary purposes, two for the bilges, with connections to the ballast tanks, which are usually pumped out by a compressed-air-driven ballast pump. The compressed air also operates the fuel-oil pumps, which draw the fuel oil from the double-bottom tanks to two daily service tanks of sufficient capacity for 12 hours working, which are placed on the engine-room tops. The function of these service tanks is to permit of the settlement of any water pumped, together with the oil from the double-bottom tanks, which are filled with ballast when empty.

The donkey-boiler auxiliaries, the fuel-oil heater, feed pump, and fuel-oil pump are naturally steam driven, and are placed in the after bulkheads, and there is an electrically driven CO_2 machine, used for the refrigerating space. The electric hydraulic steering gear of the Hele-Shaw-Martineau type has given every satisfaction.

It is interesting to note that compressed air will not be used for working the ballast and fuel-oil pumps in the next ship, as it has been found that the method of drive is neither reliable nor economical for these purposes. A critical examination of the machinery equipment of the *Selandia* reveals the fact that Messrs. Burmeister & Wain are determined to show in actual practice that the prejudice of the many sceptics is unfounded, and that where first cost and weight are not primary consideration, an installation can be designed which will meet the most stringent demand for reliability.

Below is a reproduction of an indicator diagram taken during the voyage of the *Selandia*. The mean effective pressure from the card is approximately 6.4 kg. per cm. (91 pounds per square inch) at 129 revolutions per minute, which gives the indicated horse-power for eight cylinders at 1190, or 1000 brake horse-power, assuming 84 per cent mechanical efficiency, as obtained on the test bed at the Copenhagen works. The fuel-oil consumption is about 0.45 pound per brake horse-power hour. The space in which the silencers, cooled by the feed for the donkey boiler, were placed was noticed to be hot, and it is problematical whether a mast exhaust possesses any advantages other than that of appearance over a water-cooled silencer in a funnel above the engine room. There was less smell in the engine room than in that of a steamship. The noise from the engines, what little there was, is attributable in a considerable measure to the delivery valves of the 300-pound per square inch air compressors and the lubricating oil pumps, which, latter, it must be explained, were designed and made within one week, in order to take the place of compressed-air pumps, which had not proved entirely satisfactory. The fact that the engines were of the eight-cylinder eight-crank type gave a remarkable freedom from that vibration usually associated with Diesel engines, but, as in many other ships, the synchronism of the periods of vibration at certain speeds made itself felt to those in the passenger accommodation.



The engine-room officers will number seven—two on each watch. It is, moreover, claimed that the adoption of Diesel engines has increased the cargo-carrying capacity by 1000 tons, chiefly owing to the absence of coal bunkers, since an engine and boiler room for the same power would only occupy two or three frame spaces more than the Diesel engines. The saving in weight must be small, since the machinery of the *Selandia* must weigh some 400 to 450 tons, which is equal to 250 pounds per brake horse-power for the main engines alone.

The *Selandia* has not yet encountered weather of a sufficiently severe nature to test the action of the Aspinall governor to prevent racing of the propeller, although it is stated that the governor gave satisfaction on the test bed when the dynamo load was suddenly cut off. Another interesting point will be the effect of the flywheel on reimmersion of the propeller after the governor has been in action. The maneuvering capacity of the engine was tested from West India docks to Gravesend, and proved satisfactory, although two tugs were in attendance.—*Engineering*.

The large Diesel motors built by the Maschinenfabrik Augsburg-Nurnberg, Nuremburg, for the German Navy, do not seem to have given entire satisfaction. Several months ago the cylinder of one of these motors exploded in the builders' shops. After various modifications new trials took place, resulting on January 30, in a deplorable disaster. After the motor had been going at full speed for several hours, a cylinder exploded killing three machinists on the spot and wounding mortally five more engineers and machinists who all died before morning. Furthermore, two engineers and

six workmen were seriously injured. A sequel to these accidents is that the opinion is gaining ground among engineers that high-powered Nuremburg Diesel motors upon which such hopes had been built will never be installed in the large battleships for which they were intended.—*Shipping*, Illustrated.

ADVANTAGES OF OIL-BURNING VESSELS.—The East Asiatic Company, owners of the S. S. *Selandia*, claims the following advantages for oil-burning vessels:

(1) The savings effected by using oil instead of coal may, under the oil contract made by the company over a series of years, be estimated at more than 50 per cent. (2) The increased loading capacity obtained through less weight of machinery, as well as increased cargo space gained by the absence of coal bunkers, and larger carrying capacity owing to difference in the respective weight of quantities of oil and coal. (3) Calling at ports for filling bunkers and loss of time connected therewith are avoided. A steamship on the Far Eastern trade will require to coal at eight or ten different ports, whereas a motor vessel need only take in oil at one or two ports. Further, the drawbacks attending coaling and stoking are got rid of; savings are in this way effected and expenses for maintenance reduced. Moreover, there is no heating of the vessel from the boilers, which, particularly in the tropics, is of great importance to the cargo, and also the danger of spontaneous combustion is diminished. (4) The cost price of a motor ship like the *Selandia* is about 10 per cent higher than that of a corresponding steamship, but on the other hand the loading capacity is larger by about 10 per cent, so that the gain per ton-carrying capacity will amount to about the same.—*The Engineer.*

OIL-ENGINED VESSELS IN SERVICE.—The following table from *The Engineer* gives list of these in service in April, 1912:

Summary.

Oil-tank vessels (15,000 tons, 42 H. P. largest)	about	21
Tugs	"	37
Motor sailing vessels	"	8
Merchant vessels, freight, passenger and combined vessels (9000 tons, max. 3000 H. P)	"	43
Fishing boats	"	14
Miscellaneous	"	16
Submarines	"	115
Warships	"	30
Small boats	"	20
Total		304

DIESEL OIL ENGINES IN ELECTRICAL PLANTS.—In general, the reports seem to indicate that the most serious troubles and the principal sources of expense in connection with the operation of the engines (most of which had been used from one to three years) were due to cracked cylinder heads, broken connecting rods and crank shafts, to reboring of cylinders, to carbon deposits and valve grinding, and to replacement of piston rings and fuel injection accessories, valves, needles, atomizers, etc. Cost of repairs per engine per year varied from a nominal sum up to one instance of $700, the latter high figure being mainly due to cracked cylinder heads. The average cost of repairs and renewals was between $200 and $300 per engine per year, or from 2 to 3 per cent of the cost of the engines.—*Electrical World.*

GAS ENGINES FOR SHIP PROPULSION.—*The Holzapfel II.*—This is a gas engined vessel, with its own gas plant, which was built and supplied by the Power Gas Corporation, of Stockton-on-Tees. It consists of two producers, 3 feet 6 inches square and 6 feet 6 inches high, and of two scrubbers, 13 feet

high and 2 feet 6 inches diameter. Exigencies of space on board so small a vessel forced the owners to agree to a somewhat cramped position for the gas plant, which is situated in the engine room on the port side. The arrangement as it exists on board this vessel is probably the only one, so far as the producers are concerned, which could be adopted on a vessel of her size with engines aft.

These are placed on a platform 3 feet 9 inches high, and they form part of a closed-in gas space, which is accessible by a gas-tight door from the engine room, but is not supposed to be entered, except in case of urgent need, while the vessel is under power. The working of the producers, such as blowing on, and the working of coal cocks is by levers from the engine room. The only openings to the engine room are the blowing-on cocks, which can be shut by a slide, and four inlets, which are only open while the gas plant is under suction.

The producers are lined inside with fire bricks; they were originally connected with the scrubbers by horizontal pipes entering the scrubbers at the base. The scrubbers were filled with coke to a depth of 6 feet; sea water from a tank on deck trickles down through this coke, and serves to cool the gas and to free it from any dust which may enter from the producers. Above the coke is a space containing wood wool as a further means of cleaning the gas. The cooling water is discharged into a tank underneath the scrubbers, whence it is pumped overboard by a drum pump running by a belt from the main engine. Originally a centrifugal pump was fitted for this purpose, but it was found to be quite useless, and had to be changed for a drum pump. Steam vapor is supplied by eight flash boilers inside the producers, and fresh water has to be supplied for this purpose, and this is carried in the after peak tank. In order to be able to use sea water, a new type of vaporizer has been designed, by which sea water can freely be used, and this will be fitted to the exhaust in the early future.

It may here be stated that a sufficient supply of steam vapor, *i. e.*, 1 pound of water evaporated for every pound of coal used is essential, not only for the quality of the gas, but also to reduce the formation of slag in the producers.

The vertical gas engines is by Messrs. E. S. Hindley & Sons, of Bourton, Dorset. It has six cylinders, 10-inch diameter and 10-inch stroke; it is designed to run at 450 revolutions per minute. It is a similar engine to the type now manufactured by several gas engine builders for the purpose of working electric dynamos, and, in so far as it works on the hydraulic transformer, its task is practically identical with that of other vertical gas engines on shore. The engine has forced lubrication and low-tension magneto, and also Lodge ignition.

The consumption of anthracite coal during recent runs varied between 25 and 35 cwt. per day of twenty-four hours, and was about one-half of that of steamers of similar power.

During this period several faults manifested themselves in connection with the machinery, and particularly with the gas plant. Among them it should be mentioned that the horizontal connecting pipes between scrubbers and producers several times got filled with water when the ship was by the stern, which shut off the gas from the engine and caused a sudden stoppage. As a consequence, this pipe was altered so as to slant downwards from the producers to the scrubbers.

The coke in the scrubbers, moreover, was found to gradually pulverize, and it ultimately choked the outlet, so that the water rose, and even came into the producers, putting out the fires. Since that time earthenware tubes of a design giving a maximum of surface have been placed in the scrubbers as a substitute for the coke.

The fire-brick lining of the producers was frequently covered with slag, and when this was removed the fire bricks were injured. I have suggested that interlocking blocks of steatite would be a good substitute for fire brick, as I am of opinion that slag will not adhere to this, and an experiment for putting a partial steatite lining into one of the producers is now being made.

The two levers for opening the exhaust valves of the producers were originally on the port side of the engine. It happened several times that in cases of sudden stoppage of the engine burning gas came from the producers into the engine room, when it was difficult, on account of the gas flame, to get at the levers of the exhaust valves. In order to avoid this, the shafts of the exhaust valves have been brought right across the engine to the starboard side, and so arranged that both valves can be opened by one movement. I consider it essential that such or similar arrangements should be fitted to future gas-driven vessels.

The Lodge ignition, as originally fitted, and having wax as an insulating material, was found unsuitable on account of the high temperature prevailing in the engine room, and a new design of ignition specially adapted for the vessel is now being fitted.

Another interruption in the working of the vessel was caused by the shifting and breakage of one of the oil pressure pipes. This happened at a very inconvenient time, in very heavy weather, and caused some danger to the vessel. The oil pressure pipes are now being placed in deep grooves, and very securely fixed into position so as to preclude the possibility of a similar accident.

In other respects the gas engine has worked with fair regularity, but the power given with anthracite gas is probably nearer 160 than 180 horsepower, the power guaranteed by builders, which guarantee, however, was for gas of 140 B. Th. U. The transformer has been in every way satisfactory.—*The Engineer.*

AERONAUTICS.

For the first time an Italian aeroplane has been touched by the enemy's fire. While the airman Rossi passed over a large Arab encampment in the vicinity of Tobruk carrying as a passenger Captain Montu, who succeeded in throwing bombs with good result, the aeroplane was fired upon by the enemy and was hit by four bullets, one of which wounded Captain Montu very slightly. Captain Montu is a member of the Chamber of Deputies and went to Tripoli to organize a corps of volunteer airmen.—*United Service Gazette.*

The use of the dirigible as a weapon of offensive warfare was tried with apparent success by the Italians at Aziziah in Tripoli on May 2, when, according to a terse official report sent to Rome, two of the new dirigibles sailed over the camp and dropped thirty bombs, practically destroying the enemy's position, and resulting in heavy loss of life. The Turks tried to utilize their field pieces to destroy the dirigibles with shrapnel, but they could not fire at sufficient elevation, and the explosives fell far short.—*Army and Navy Journal.*

AERONAUTICS IN FRANCE.—The latest figures with regard to aviation and aeronautics in France are $4,800,000 for aeroplanes and $1,600,000 for airships. Fifteen of the latter type will be constructed, and at the end of 1912 it is proposed to have 334 aeroplanes in operation. At the present time the French Army has over two hundred. These aeroplanes, which are known as avions, are to be divided into flotillas of eight machines, six of which are to be always in full commission with two in reserve. These six machines are to consist of two monoplanes and four biplanes, divided into pairs and intended to carry one, two, and several men. The reserve machines are to be one monoplane and one biplane. The 208 avions now possessed by the army have been divided into thirteen flotillas, eight for field and five for garrison use. At the end of the year it is expected to have twenty-seven flotillas in the field and five for garrison work. A special flotilla of powerful high-speed machines will be attached to each of the field armies in time of war, for long distance reconnoissance work. Each flotilla is to have seven pilots, a quartermaster, four non-commissioned officers (including a chief engineer), and forty-four men.—*Scientific American.*

Progress in aviation matters is a commendable feature of the French fighting administration. The advance made by the army is now being emulated in the navy, the Minister of Marine having decided to use the Montpellier aerodrome for the trial of hydroplanes and the training of naval airmen. At present, the French Navy has an aeroplane at Buc, and a Voisin hydroplane is on order which will begin its trials at Toulon on April 15. The cruiser *Foudre* has been specially prepared for aviation work and has been fitted with a platform for the landing of aeroplanes. The Montpellier aerodrome will only be used provisionally until that of Fréjus, which will be the headquarters of the Naval Air Corps, is ready. The land necessary has already been provided for, and the plans of the various buildings required are completed. The Supplementary Naval Estimates admit of the purchase of ten machines, a number that will be sufficient to permit of a definite estimate being made of the services which aviation will be able to render to the navy.—*United Service Gazette.*

A new era has been opened in the matter of directing artillery fire at targets unseen by the gunners from information furnished to them by aerial scouts. Performance of aeroplanes in the Continental maneuvers of 1911. Captain Bellenger in a single-seated monoplane and Captain Casse, Lieutenant Blard and Lieutenant Menard (each accompanied by an observer) in three double-seated biplanes were directed to reconnoiter the scene of operations of an enemy supposed to be advancing on Verdun and to report the effect of artillery fire from their own side. The latter fired live shell, but, of course, only marks or dummies represented the force of the enemy, which were invisible to the gunners owing to the elevation of the ground between them and their objectives. The aviators rose to a height of 4000 feet to comply with supposed conditions of safety, circled around over the enemy during the engagement and by means of dropped messages indicating the results of the firing from time to time rendered the shooting far more effective.

The success of the aerial scouts in the French and German exercises has developed a tendency among enthusiastic advocates of the aeroplane to assume that the army airman will entirely take the place of the cavalry scout, but it is well to point out, says the London writer, that it is unreasonable to suppose that the aeroplane can do more than very considerably lighten the labor of the cavalry reconnoissance and allow the mounted troops more rest and more freedom for purposes of tactical aggression while at the same time reducing the strain on the horses. On September 9, during the French maneuvers, not one of the twenty-four aviators on both sides could go up on account of the weather. Such weather crippling of the activity of air scouts and other dangers and mishaps must be taken account of and the net result is to make it plain that it would be most unwise to rely upon the continuous efficiency of aerial scouting in any form, if unsupported by mounted troops forming a protectice screen against the scouting enterprises of the enemy's cavalry.

The general adoption by the different nations of neutral-colored uniforms is destined to decrease materially the efficacy of the air scout, according to this British student of aeronautics, for whereas hitherto it has been comparatively easy to distinguish friend from foe by the distinctive uniforms with the universal introduction of field service uniforms of grey-green or or mud-color, calculated to make the wearers as little conspicuous as possible, the problem of distinguishing friendly from hostile troops and even of distinguishing scattered troops at all when flying rapidly at a safe elevation will be much more difficult than now. It is hard to say what the aerial patrol will be able to do for his own side in wooded country. He will be visible and possibly audible to the enemy but he will see next to nothing himself. In misty weather he will lose his way and see nothing at all. The ease with which air scouts can be deceived by false dispositions and dummy field works will also tend to vitiate the work of the fliers. In the German Army maneuvers of 1910 the "red" army laid out a dummy position with elaborate

field works which completely fooled the air scouts of the "blue" army, although they were in a dirigible and had a steady platform for observation. —*Army and Navy Journal.*

RADIO.

RADIO IN THE SAHARA.—Signor Marconi announced that no poles or masts are needed in sending radiograms across the desert. Lay the wires along the sand a short distance in the direction in which the message is to be sent, and, due to the complete dryness and non-conductivity of the sand, the apparatus performs its functions as well as before. It is claimed that messages sent in this manner cannot be intercepted.—*Scientific American.*

FRENCH FISHING FLEET.—Following the example set by the German government, a credit of $50,000 has been asked from the French government to encourage the installation of wireless telegraphy in French fishing smacks. Boats carrying their own apparatus will receive an installation bounty of $400 and an upkeep allowance.—*Shipping,* Illustrated.

ENGLAND'S COASTGUARD RADIO OPERATORS.—It is directed that officers and men of the wireless telegraphy section of the coastguard will only embark in the fleet for a cruise of 28 days once in two years, instead of embarking every year as at present. With regard to the signal section, no more embarkations in the fleet are to take place, but the officers and men are to undergo a course of training of 28 to 35 days once every four years in the Signal School at Portsmouth.—*United Service Gazette.*

ENGLISH CHAIN OF STATIONS.—The Marconi Wireless Telegraph Co. has received a dispatch from its headquarters at London advising it of the completion of a contract with the British government for the erection of a chain of wireless stations, to be known as the Imperial Wireless Chain, linking together a number of the colonial possessions of the British Empire. Among the chief stations of the chain are to be those at London; in Egypt, at the northerly entrance of the Red Sea, and at Aden, at the southern extremity of the Red Sea, both on the eastern route to India; at a central point in India; also at Singapore, in the Straits Settlements, on the route to the Far East, and at Pretoria, South Africa. These are to be the nuclei of further stations in this chain, which is designed to extend the service gradually so as to link London with all the British possessions beyond the seas. The British government allows £60,000 for each station, exclusive of sites and buildings, and allows the company 10 per cent of the gross traffic receipts for the duration of the contract, which lasts twenty-eight years.—*Shipping,* Illustrated.

NEW METALLIC MAST.—An extensible metallic mast for use in connection with wireless work is being experimented with in Germany. The apparatus is not telescopic, but involves a new and novel principle.

Four flexible steel strips are wound on drums, so placed with relation to each other that a four-sided hollow column is formed by the strips when fed from the drums. The strips are provided with teeth and recesses in their edges, which engage in each other as the mast is projected. A light portable mast, having a base about three feet square, can be raised to a height of sixty-five feet. When lowered, the apparatus is six feet high and weighs 385 pounds.—*The Navy.*

JAPAN.—In wireless telegraphy the Japanese have completed a large station at Darien by which they are connected with the Asiatic continental chain of wireless stations. The Japanese naval experiments with wireless communication with vessels of the Japanese trans-Pacific fleet have been satisfactory. The Japanese Navy has introduced aviation and among other aeronautical machines they have adopted a hydroplane.—*Marine Rundschau.*

PANAMA EXPOSITION TOWER.—A memorial tower over 1000 feet above sea level will be built in Lincoln Park, San Francisco, in connection with the Panama Exposition. The possibilities of such a tower for wireless work has appealed so strongly to the Secretary of the Navy that he has issued the following statement on the subject:

The Navy Department is taking steps towards erecting a high-power station on the California coast, in connection with its chain of wireless stations across the Pacific and for communication with ships in the eastern Pacific Ocean. Since the range of wireless depends principally upon the height of the aerial wires above the ground, and since the location of this station at San Francisco would be most advantageous to that city, it would seem that the memorial tower should be erected with a view to its use for supporting one end of an aerial of the most powerful wireless station in the world. The Eiffel Tower in Paris, 1000 feet high, has produced wonderful results in long distance wireless work, and the proposed tower would insure even more remarkable results.—*The Navy.*

MISCELLANEOUS.

HOW TO TEST METAL POLISHES FOR EXPLOSIVE PROPERTIES ON BOARD SHIP. —R. E.—The following order was published by our Navy Department some time ago:

SPECIAL ORDER NO. 1. NAVY DEPARTMENT, Jan. 11, 1912.

As certain brands of metal polish have been found to be explosive, all brands on board ship shall be tested, and those containing explosive gases shall not be allowed or retained on board, unless they are stowed on upper deck.

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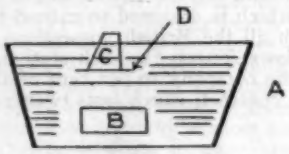
While a way to carry this out may, to most of us, be perfectly apparent, still, the following method suggested by Mr. G. W. Patterson, of the Naval Smokeless Powder Factory, may prove useful:

Take a pail or dish pan "A" that is large enough to hold the polish can "B" comfortably and completely under water; a tumbler, tin cup "C" or any suitable-sized collector to be inverted under water; and a plate of glass, wood or metal "D."



Punch one or more holes in the can of polish "B" under water, and preferably warm it in water before the trial. Any gases which may escape collect in cup "C," and the latter with its mouth covered with the plate, carry to a convenient location, and test with a burning match or splinter.

NOTE ON THE HYDRAULIC INTERACTION BETWEEN PASSING VESSELS, CALLED "SUCTION." (See No. 140).—*Titanic* and *New York.*—

April 10, 1912.

Very slowly the *Titanic* left her pier, until she came opposite the *New York,* of the American Line. Suddenly there was a noise like minute guns going off. Seven of the hawsers holding the *New York* to her pier had parted.

The big steamship soon came to a standstill and her three tugs went to the assistance of the *New York,* barely 15 feet separating the two vessels. The tugs got the *New York* back to her pier without a mishap. Then the *Titanic* proceeded down Southampton water on her way.

The *Titanic* is 882 feet 6 inches long, has a beam of 92 feet 6 inches, displaces 66,000 tons and is of 46,000 tons net register.—*Baltimore Sun.*

NOTE ON THE COLLISION BETWEEN H. M. S. "HAWKE" AND R. M. S. "OLYMPIC." (See Nos. 140 and 141.)—The ram of the cruiser *Hawke*, which collided with the *Olympic*, has been found by divers off Cowes. From private advices it appears that the position of the find was 1200 feet from where the *Hawke* was stated at the trial to have been at the time of collision; that is, 1200 feet more to the eastward and a little more to the north of the channel. This would tend to corroborate the evidence given by the officers of the *Olympic* and, furthermore, would tend to show that the *Hawke* had ample room and that the *Olympic* did not make a converging course for the buoy after entering the channel. The appeal from the decision of the Admiralty Court which found against the *Olympic* will be heard in June and it is expected that in view of the fresh evidence just brought to light, a new trial will be ordered and that this time the boot will be on the other foot.—*Shipping*, Illustrated.

THE "KANGAROO."—This is a vessel, built and designed by Schneider & Co., at their Chalon-sur-Saône works, for the purposes of transporting submarines and submersibles over the sea, of docking submarines as in an ordinary dry dock, and, as cargo, to carry all heavy or clumsy material such as turbines, boilers, engines, locomotives. The movable cranes being of great power.

Towing, crossing the Atlantic under their own power, were both impracticable, hence the design of this ship which takes the submarine or submersible into its hold, and thus by analogy receives its name. The vessel has three parts: the forward, shaped as in an ordinary vessel, but fitted with movable entrance in stem making a tunnel through which the boat enters to the large central hold forming the second part. This hold is 193.5 feet long and is really a floating dock where the submarine is shored up on a line of blocks and on appropriate crib work. The third part contains the motor of 850 horse-power, giving 10 knots speed, and the quarters of the crew. Other dimensions are length 305 feet, beam 39 feet, displacement 5450 tons. The first voyage of this vessel will be made soon, and will carry to Peru a large submersible boat.—*Le Yacht.*

TIME TO COMPLETE BUILDING OF BATTLESHIPS.—England: *Vanguard*, by Vickers, two years and twenty-three days. *Hercules*, by Palmers Company, two years and thirty-five days, and the average time to build the fifteen *Dreadnoughts* was two years four and one-half months—all from the order.

Germany: The *Westfalen* and *Nassau* were completed two years and nine months after their laying down; the *Thüringen* in three years and three months from the order. The average of the eight completed German ships was three years and two months.

COST PER TON.—The cost per ton of the latest *Dreadnoughts* is less in Great Britain and the United States than in other countries: the *Orion* costing £83 per ton, and the *Utah*, £87; while the *Thüringen* cost £100; the *Danton*, £122; the *Cavour*, £118.—*The Navy.*

CHRONOLOGICAL STORY OF THE OLD "MAINE."—Aug. 3, 1886, Congress authorized construction.

Oct. 18, 1888, first section of keel laid.

Nov. 18, 1889, launched at Brooklyn Navy Yard, sponsor, Alice T. Wilmerding.

Feb. 15, 1898, sunk by an explosion in Havana Harbor, while peacefully lying at anchor, 275 officers and men killed.

March 29, 1898, Court of Inquiry finds warship destroyed by explosion from outside.

April 21, war with Spain, precipitated by sinking of *Maine*, declared.

October, 1910, work of raising begun.

Feb. 4, 1912, *Maine* afloat inside of cofferdam.

March 16, *Maine* "buried" in 3600 feet of water in the middle of the Gulf Stream, nine miles off the Cuban shore.

March 23, 1912, funeral services and exercises at State, War and Navy Building, Washington, at 2.15 p. m. Interment of remains at the Arlington National Cemetery, same date.

THE BURIAL OF THE "MAINE."—About nine o'clock on the morning of the burial day, March 16, 1912, the battleship *North Carolina* and the scout cruiser *Birmingham* entered the harbor of Havana. An hour later the coffins containing those victims of the disaster that were not recovered until the *Maine* was raised, were borne upon the shoulders of Cuban artillerymen to the battleship *North Carolina*. Sixty-six of the ill-fated crew were found in the wreck, and these have since been buried at the Arlington National Cemetery (on Saturday, March 23).

At 2.15 the signal was given for the start of the funeral procession, and as minute guns boomed from Cabanas Fortress the remains of the old battleship were towed out of the harbor by three tugs, one in the lead and two at either side, to hold it to its course. The American battleships fell in line and were followed by four Cuban gunboats. Dark clouds spread a pall over the sky, and a heavy swell disturbed the sea. At intervals of a mile the *North Carolina* fired signal guns. When about four miles from shore, the American vessels took position to the right of the wreck and the Cuban vessels to the left, while other ships ranged fore and aft to complete the square. A detail of sailors boarded the *Maine* and opened the sea cocks. Very slowly the old hulk began to settle. The marine band played the National anthem. The bulkhead end was first submerged leaving above the water only the stern, from which flew an immense flag. Twenty minutes from the time the sea cocks were opened, the decks gave way under the pressure of the air beneath them. As the setting sun broke through the clouds, the water closed over the *Maine* and its flag. Taps were sounded and then the sirens of the warships wailed a funeral dirge. Thousands of roses that had strewn the deck of the vessel floated on the surface of the sea, marking the grave of the old ship. The *North Carolina* and the *Birmingham* fired a parting salute, and then proceeded on their way home with the bodies of the victims. Thus ended the most impressive funeral ever held at sea.

In the harbor of Havana there still remains the cofferdam with which the wreck was raised. This must be removed, together with the stone that was poured into the crib work, when all traces of the tragedy will have been wiped away.—*Scientific American.*

THE LOSS OF THE "TITANIC."—The dimensions and general characteristics of this, the largest vessel then afloat, were as follows: 882 feet 9 inches long, 92 feet 6 inches beam, and of 46,000 tons gross register, and displacing from 51,000 tons to 60,000 tons. Length between perpendiculars, 850 feet. She had three screws, each wing propeller being driven by reciprocating engines of 15,000 indicated horse-power, the center propeller being driven by an exhaust turbine of 16,000 shaft horse-power. For going astern the wing propellers only were available.

The S. S. *Titanic*, on her maiden voyage, left Belfast on April 2, Southampton on April 10. On the afternoon of April 14, the S. S. *Amerika* reported to the *Titanic* that she had just passed two huge icebergs in Lat. 41° 27′ N. and Long. 50° 3′ W. That same evening, the *Titanic* was steaming westward at 21 knots, weather clear and bright starlight, when ice was reported ahead. The engines were stopped, reversed, helm put hard astarboard, and bulkhead doors closed from the bridge, when, immediately, at 11.40 p. m., April 14, in Lat. 41° 16′ N. and Long. 50° 14′ W.—or just 13 miles S. 33° W. of where bergs had been reported to her in the afternoon—she struck an iceberg whose submerged ledge tore out all her star-

board bilge. Boats were manned, lowered, and sent clear of the steamer. The *Titanic* sank at 2.20 a. m., on Monday, April 15, 1912. About 8 a. m., the Cunard S. S. *Carpathia*—called by radio from the sinking vessel—arrived on the spot, and picked up and cared well for the occupants of the boats. There were 1652 lives lost and 708 souls saved. Another reliable authority places it at 1635 lost and 705 saved. The cost of this vessel was $8,487,500, and her cargo on this trip was of enormous value.

The lessons to be learned from this accident are:

(1) Steamships must be navigated with more care for safety of passengers and crew, and great risks should not be taken.

(2) Steamships must be built more on navy requirements as to cellular water-tight subdivision of hull.

(3) A more southerly track, clear of ice, should be used.

(4) More boats and other appliances for saving life should be provided.

From an examination of the plans of the *Titanic* we learn, to the great astonishment of every naval officer, that her double bottom did not extend up her sides at all, as is case with *Mauretania* class built to navy requirements, so that the opening of her side left no alternative but that of sinking, and in other words, there were no subdivisions of her hull similar to wing passages of men-of-war, or to auxiliary cruisers. Her compartments were few and all extremely large. The design of the *Great Eastern*, with the double hull extending 10 feet above the water-line, with its 10 transverse bulkheads carried to the highest deck, shows it to have been one of the safest, if not the safest, passenger ships ever constructed. The *Titanic* had but 15 water-tight compartments and these bulkheads were carried only ten feet above water-line, and then not to a water-tight deck. The average length of her compartments was 53 feet. As to boat capacity, much difference of opinion exists. The Board of Trade rules call for a boat capacity equal to fifty per cent of the total number carried. Accidents seldom happen in weather in which boats could be used at all.

BOOK NOTICES.

"Modern Seamanship." By Rear-Admiral Austin M. Knight, U. S. Navy. New York, D. Van Nostrand & Co., 1910, 531 pages, 159 full-page plates. Price $7.50.

This is the fifth edition. The first edition appeared in April, 1901.

In the present edition, about one-half of the material retained from former editions has been re-written, a large part of the remainder revised, and the following chapters added:

Chapter 19—Handling Torpedo Vessels and Submarines.
Chapter 20—Keeping Station and Maneuvering in Squadron.
Chapter 25—Hints for Junior Officers.

The revision of Chapter 12, "The Rules of the Road," is practically new. All of the chapters in previous editions which dealt with sailing vessels have been omitted, except that a brief description of such vessels is included in the Appendix, because the author believes, and wisely, that some mention should be made of this matter, though as part of a naval officer's profession, it is nearly obsolete.

The care and skill with which the book has been prepared, both by the author and the publisher, deserve admiration, unqualified and positive. Both in general plan and in detail, the book leaves nothing to be desired. Every department of seamanship is covered; every appliance and every method is explained in words, and illustrated by plates, with perfect clearness and completeness.

The scope of the work may be indicated by stating the headings of the various chapters, which are as follows:

Chapter 1—The Hull and Fittings of a Ship.
Chapter 2—Rope; Knotting and Splicing.
Chapter 3—Mechanical Appliances on Shipboard.
Chapter 4—Blocks and Tackles.
Chapter 5—Handling Heavy Weights.
Chapter 6—Log and Lead; Submarine Signals.
Chapter 7—Boats.
Chapter 8—Handling Boats in a Surf.
Chapter 9—Ground Tackle.
Chapter 10—Carrying Out Anchors.
Chapter 11—The Steering of Steamers.
Chapter 12—The Rules of the Road.
Chapter 13—Maneuvering to Avoid Collision.
Chapter 14—Piloting.
Chapter 15—Handling a Steamer Alongside a Dock.
Chapter 16—Placing a Ship in Dry Dock.
Chapter 17—Weather and the Laws of Storms.

Chapter 18—Handling Steamers in Heavy Weather.
Chapter 19—Handling of Torpedo Vessels.
Chapter 20—Keeping Station and Maneuvering in Squadron.
Chapter 21—Towing.
Chapter 22—Rescuing the Crew of a Wreck.
Chapter 23—Man Overboard.
Chapter 24—Stranding.
Chapter 25—Hints for Junior Officers doing Line Duty.
Appendix.

The thoroughness with which these various subjects have been treated may be indicated by stating that the book comprises 531 pages, each page 9" x 6", besides 159 full-page plates, and that the language is extremely terse.

Perhaps the best chapter in the book is the chapter on The Rules of the Road. It is hard to see how this chapter could be improved. While the rules of the road were doubtless intended to be very simple, it is a matter of fact that they are not simple at all; and it is also a matter of fact that some of the rules are expressed very ambiguously in the law. In Admiral Knight's book, the rules are not only given, but they are commented on with much elaboration, and explained with minute care and clearness. Citations from legal decisions are given, and many cautionary remarks are made, pointing out where the rules have been sometimes misinterpreted, and are liable to be misunderstood. The rules are illustrated with thirty-five excellent diagrams, nineteen of which are partly in color.

It is evident that Admiral Knight has a just appreciation of the importance of a thorough understanding of the rules of the road, which is perhaps the most important single subject in seamanship, and that he spared himself no labor in elucidating them. No officer can read the chapter on The Rules of the Road without receiving benefit.

One of the distinctive features of the book is the elegant clearness and conciseness of the diction. That such beautiful English should be used throughout a purely technical work is perhaps surprising, but certainly it is desirable, because it lightens the labor of understanding, and renders study attractive. This merit appears in its most pleasing form in the chapter on the Laws of Storms, which the author makes not only extremely instructive, but intensely interesting also.

This chapter is so fine that it is to be hoped that Admiral Knight will go into the subject still more deeply. It is a subject that concerns the seaman intimately, and yet most of us realize that there is a hiatus in the theory somewhere. This chapter is commended to the earnest attention of every officer, not only because it is so good in itself, but because its clear exposition of the present theory makes the subject so alluring that it may stimulate some one to take it up as a specialty, gather fresh facts, and formulate some laws which will help us to foretell the weather better than we can now.

All the chapters are good, all the subjects are well handled, all the explanations are clear, all the conclusions are correct. The book is intended primarily for naval officers, especially for the younger officers. It deals

mainly with conditions as they are in the naval service; and yet the principles it enunciates, and the methods it describes, apply to all departments of the seaman's art, and vitally concern those who cruise in the merchant service also. It is a book which every seaman, no matter how well versed he may think himself to be, should consult with the greatest care, and keep always at hand for reference.

BRADLEY A. FISKE, Rear-Admiral, U. S. Navy.

"Interior Ballistics." Third Edition, 1912, by James M. Ingalls, Colonel, United States Army (retired). New York: John Wiley & Sons, 1912. 186 pages. Three tables for use in computations. Price $3.00.

"When, in the summer of 1889," as stated by Colonel Ingalls in the Preface to the edition of 1894 (Second Edition) which forms a first preface in the present book, "it was decided by the staff of the Artillery School to add to the curriculum a course of interior ballistics, the instructor of ballistics, knowing of no text-book on the subject in the English language entirely suited to the needs of the school, employed the time at his disposal before the arrival of the next class of student officers in studying up and arranging a course of instruction upon this subject, so important to the artillery officer. The text-book then planned was partially completed and printed on the Artillery School press, and has been tested by two classes of student officers.

"In the summer of 1893 the author again had leisure to work on the unfinished text-book, but in the meantime he had found so much of it which admitted of improvement that it was decided to rewrite nearly the entire work as well as to complete it according to the original plan by the addition of the last two chapters.

"With the exception of portions of Chapters IV and V, the author claims no originality. He has simply culled from various sources what seemed to him desirable in an elementary text-book, arranged it all systematically from the same point of view and with a uniform notation."—Artillery School, February 15, 1894.

"The Second Edition," as stated in the Preface proper to the present edition of 1912 (Third Edition), "was used as a text-book at the Artillery School until the school suspended operations at the outbreak of war with Spain, in April, 1898. This edition, having become exhausted, the author has been induced by the request of officers for whose wishes he has great respect, to prepare a new edition embodying the results of some investigations which were published in Volumes 24, 25 and 26 of the Journal of the United States Artillery."

The First Edition it seems was never issued, if published.

By the way of introduction, and before proceeding to a more extensive review of this book, it will be worth while to indicate as briefly as possible the method used. This can be fairly well done in a paragraph by referring the reader to a paper published in the PROCEEDINGS OF THE UNITED STATES NAVAL INSTITUTE, Volume XIV, No. 2, 1888, Whole No. 45, under the

caption "Velocities and Pressures in Guns," by Ensign J. H. Glennon, U. S. Navy. If on page 403 of this number, the fifth line, reading,

"Integrating (9), replacing (n—1) by .4 or 2/5,"

is changed to read,

"Integrating (9), replacing (n — 1) by 1/3,"

and the integral as thus changed is tabulated, as it can be much more readily than the unchanged integral, all else except the value of n, which is changed throughout, to remain as it is there, that is, if all the other functions named there are based in exactly the same way on this new integral, which in its general form is the key to the whole matter, and if the velocities and pressures are expressed by exactly the same formulæ, and are used in exactly the same way, the method will be completely and exactly, even if briefly described.

NOTE.—The radical sign prefixed to the denominator of this changed integral as shown in equation (9) page 82, Ingalls' Interior Ballistics, Third Edition, is a typographical error, and should be omitted.

If, in addition, the formulæ are deduced without the aid of the so-called "general equation of motion" in a gun, but directly from the thermodynamic laws of gases, as was done in the Interior Ballistics by Lieutenant J. H. Glennon, U. S. Navy, published in 1894, a method of initial procedure used by Colonel Ingalls in the present Third Edition of 1912 (but not in the Second Edition of 1894) will be covered also.

The key integral above referred to was new in the paper on "Velocities and Pressures in Guns," and does not belong to Sarrau or other previous writers. There is no suggestion in any of their writings as to dropping the solution by series as used in the French and other Continental books, and it involved a distinct heresy from their methods. It would seem that any reference by Colonel Ingalls to this paper on "Velocities and Pressures in Guns" must be looked for in the comprehensive predicate found in his Preface to the Second Edition of 1894, viz.:

"culled from various sources,"

and it is not elsewhere mentioned in the prefaces or subject matter of the Third Edition; nor is its author. It would also appear aside from the personal predilections of the Colonel and his possibly better arrangement of the subject for the use of student officers that any originality of *method* if it can be so called comprehended in the statement in his Preface to the Second Edition, viz.:

"With the exception of portions of Chapters IV and V, the author claims no originality"

consisted in substituting 1 1/3 for 1 2/5 as the ratio of the specific heats of the powder gas. And in this connection, "lest we forget," the following from a continuation of "Velocities and Pressures in Guns," entitled "Powder in Guns" (see page 28, Whole No. 52, U. S. NAVAL INSTITUTE PROCEEDINGS, 1890), is illuminating:

"I do not consider n = 1.4 as final or necessarily the best value; n is greater than 1 and probably not greater than 1.4. Tables could just as readily be calculated for 1.2 or any other value as for 1.4."

The chapters referred to, it may be noted, contained the meat of the whole subject, especially in so far as it was new.

Formulæ of this kind require extensive test. The original tables in "Velocities and Pressures in Guns" were based on theoretical considerations, pure and simple, at a time when this and kindred subjects in ordnance and gunnery were being developed by officers of the army and navy, and many of the elements of the loading of guns were still indefinite or inaccurate. The ratio assumed for the specific heats of the powder gas was that for perfect gases, or 1.4. Many still believe this the best value for that ratio per se in spite of some evidence to the contrary, as this gas is very far removed from the liquid or solid state by its high temperature. The deduction of these formulæ involved as well an assumption that there existed in the products of combustion of the black or brown powders to which they were applicable a non-gaseous residue equal in volume to the total volume of the original powder grains. It was and is well known that this assumption could not be true with any exactness; and in the application of the formulæ, the use of 1 1/3 in place of 1 2/5 has an influence corrective at least in part, for this very inexactness. But the author goes further. He applies these formulæ to smokeless powder, both cordite and nitro-cellulose, where there can be no such non-gaseous residue, and shows in his applications that the formulæ with his tables have about the same relative exactness when used with these smokeless powders that they had when using the original tables (where 1.4 was used as the ratio of the specific heats of the powder gas) with the earlier common powders. This naturally impels one to suggest that a still further adjustment of this ratio to meet the greater inexactness of the volume of the non-gaseous residue (with smokeless powders) would probably have given even better results than are shown in the "Applications." The results are, to be sure, sufficiently astonishing.

The complete method with formulæ and solutions, and working tables sufficient for those who use them only occasionally, but who are familiar with the properties of gases, could be placed on four or five printed pages. The uses, explanations, applications and tests of the formulæ are of course very much more important from a practical point of view, and the present book which gets out of them about everything that can be gotten except Sarrau's own formulæ for black or brown powders (which could readily have been gotten by the use of certain approximations admissible in practice) covers, aside from title page, prefaces, table of contents, tables of functions and a chapter on the rifling of cannon, one hundred and sixty-nine printed pages. The labor involved was of course very great, and, especially if viewed in retrospect, after the fact, very much greater than the labor of production and combination of the ideas embodied in the original formulæ.

We will now go into the subject matter in some detail. After an introductory chapter with definitions and an early history of Interior Ballistics covering many old familiar names, the author breaks ground on his subject proper with a deduction of the thermo-dynamic laws of gases, such as may be conveniently found in Sarrau's researches and elsewhere. He then deduces a velocity formula for any travel of a projectile in a gun when the

weight of powder burned to the corresponding instant is given. It is to be remarked that Sarrau has this same formula,* but as will become obvious by noting the character of his later velocity formula for quick powders (which involves the shape of the powder grain) he either abandons it, or fails to note its full significance. (See equations (21) and (22), pages 89 and 91, U. S. NAVAL INSTITUTE PROCEEDINGS, Whole No. 28.)

After proceeding thus far in a direct line towards his final formulæ, the author digresses for a while to present the other view of the subject as given by Messrs. Noble and Abel. In their method, the gases and non-gaseous residue are assumed to remain at an equilibrium of temperature, as the gases expand in a gun, the expansion being otherwise adiabatic. Sarrau assumes the gas expansion as strictly adiabatic. Noble and Abel do not get into the theory of progressiveness in powder at all, though what is called their factor of effect will correct differences of velocity with different guns and different elements of loading. The author is apparently careful that the methods of Noble and Abel are not confused with his own, for in the twenty or more pages devoted to them in this part of the book, he mentions one or both of them on an average of about once to each page. And though he quotes their experiments and deductions extensively, he is not following their method at all.

He then returns to his subject proper, takes up the progressive combustion of grains of powder, and resorts to a formula involving the fraction of the least dimension burned, a simple device to be sure, but a departure from the usage of Sarrau and others, and a coincidence with that in "Velocities and Pressures in Guns." (See equation, 12th line, page 403, U. S. NAVAL INSTITUTE PROCEEDINGS, Whole No. 45, and equation (22) page 72, Ingalls' Interior Ballistics, Third Edition, noting further use.)

Finally, in spite of the opinions of several later authorities, he adopts Sarrau's law for the velocity of combustion of powder, namely: "The velocity of combustion varies as the square root of the pressure of the surrounding medium." And he is probably right in so far as any single power or root would suit the case. There is room for considerable comment as to this matter, but it would require a chapter in itself. It cannot be treated superficially, and we will not attempt it here. This law, however, leads the author directly to a particular concrete expression by formula for the velocity of combustion of powder under variable pressure. (See equation (2), page 80, Ingalls' Interior Ballistics, Third Edition, and last equation, page 402, "Velocities and Pressures in Guns," U. S. NAVAL INSTITUTE PROCEEDINGS, Whole No. 45.) This formula, simple as it may seem, is also a departure from the previous beaten path.

Sarrau bases his final formulæ on a premise that the volume of the solid (non-gaseous) residue of burning gun powder at the temperature of combustion is equal to the total volume of the powder grains. This is his own; it is based on a careful analysis (of other peoples' experiments), and he had the clearness of perception to seize it for future use, and place it in a working formula for a progressive powder. The same value was taken in

* Sarrau does not use the special form where 1 1/3 is substituted for n.

"Velocities and Pressures in Guns," and the same is taken here. And not only that: The formulæ as originated were for black and brown powders where the premise was at least approximate; Colonel Ingalls, as previously indicated, shows by his examples that the formulæ are fairly applicable to smokeless powders. And he has gone into their application with a degree of elaboration all his own, a tremendous piece of work, and complete to many of the finest details. He omits, however, to discriminate between the maximum pressure on the breech block and that on the projectile, as well as the maximum *effective* pressure on the projectile, and it is believed that the results would have been even better than they are, if he had done so. As it is, the results with the cordite-using, 100-caliber, 6-inch gun of Captain (now Sir) Andrew Noble are sufficiently impressive, and show the exactness that may be expected with these formulæ and the author's tables, if care and intelligence are used. The results with nitro-cellulose powder are of the same character. The author is to be heartily admired and congratulated on his faith in these formulæ, and his determination to make others see that they are practical. As they stand, they are not foreign, and have never been accepted abroad; or, if so, the fact has never been acknowledged. His voluminous applications literally force them down the adversary's throat, so to speak. It is not probable that short empirical formulæ (possibly due to these) will be abandoned for ordinary occasions of firing at the proving grounds, because of their relative simplicity, but the study of improvement and other questions in the use of powders will have to be made along these very lines. And the author has been brave to submit such a compendium of actual statements with figures to the critics, for if incorrect they can be mercilessly torn to pieces. It is impracticable to follow out all the details of these now. They are presumably correct, and will be left unquestioned here.

It seems an opportune time, however, to notice the following statement on page 159:

"A comparison of these results with those deduced in Problem 1 shows the great superiority of the uniperforated over the multiperforated grain so far as maximum pressure is concerned. The muzzle velocity is the same in the two cases," etc.

This is true as it stands for the grains used, but hardly fair, as the uniperforated grain used has a length of 50 inches while the multiperforated is about one inch in length. It is not true for uniperforated grains of the latter length. Where the multiperforated grain in fact loses out is in its comparatively short length. There are two ends to every cylinder, which in powder constitute additional surfaces of emission and these surfaces cause additional maximum pressure. Proper variations of length enable one to adjust the maximum pressure and initial velocity. But there is a limit to the length of grain imposed by certain other conditions. The first is freedom of movement of the grain in the gun in order to take its proper position in the chamber, so that there will be what might be called equilibrium of explosion. It can readily be understood, let us say with equal spherical powder grains in a closed chamber, that the burning grains, with gas at a high pressure issuing in all directions, are, with their freedom of movement, suspended by their practically equal

repulsions as regards each other, and the neighboring surfaces, in such a way as to be distributed very evenly throughout the chamber. Short multiperforated grains follow very closely the same rule.

But if the grains are long, and arranged fagot form the repulsions between grains are sidewise in direction, the gas from the fagot as a whole escaping at both ends, and the tendency is not so much to separate the grains evenly throughout the chamber as, according as the pressure at either end prevails, to shoot the fagot bodily from one end of the chamber to the other, bringing on a condition there that will shoot it bodily back again shortly and so on.

The pressure may thus be abnormal in places due to the immediate presence of the source of gas; the gas at formation is very much higher in pressure than the average pressure in the chamber can ever be, and though this highest pressure is never manifested on the gun, the stream lines of the flowing gas have in their various parts pressures dependent on their position in the stream. This hampering of the escape of the gas with its increased pressure moreover augments in turn the velocity of emission and it is plain that there can be no equilibrium of explosion, if we may call it so. Under such circumstances dangerous wave pressures may readily be set up. If the inequalities of pressure force the individual grains lengthwise differently, they may get separated out from the fagot and from each other, relieving the situation. But even then from their length they may become snarled in various places, making several violent and unequal centers of explosion which would, however, be better than one center. Or by twisting and writhing around each other, they may break up, thus rendering the pressures uncertain because of the creation of new surfaces of emission. If the powder is all burned at the muzzle, the velocity will be normal, but the gun will have been placed under unnecessarily severe and irregular strains. It is thus well worth while to consider carefully the limiting length of the grain that will admit of free movement.

If now we sacrifice some freedom of movement of the individual grain to get a better theoretical form, we can still have a second form of freedom in a number of centers of emission, as with several short fagots placed end to end which repel each other lengthwise of the bore. This will constitute an equilibrium of a certain type, the resulting waves being much shortened and the burning of the grains fairly uniform.

It should be remarked here that the full value of any abnormal pressure with long fagots will rarely or never be communicated to a crusher gauge in the breech block, being manifested on the sides of the gun in the neighborhood of the fagot and damped by the gas at lesser pressure in the spaces ahead and in rear of it.

The true function then of the holes other than the axial hole in the short multiperforated grain is to supply the deficiency in the grain due to its shortening and the rapid decrease in area of its end surfaces, as it burns. And if we can do this, and equal theoretically the long single perforated grain, we can combine a proper freedom of movement to prevent wave pressures with a curve of pressures suitable to a long hollow projecting beam (such as a gun) which from considerations of vibration and drooping should have a proper taper. A charge of long multiperforated grains

could readily be made which, without any abnormal pressures, would blow off the muzzle of such a gun; and abnormal pressures have blown off the muzzle of at least one navy gun in a case where long single perforated grains were used.

The author makes a statement on page 154 to the effect that there is a sudden drop in pressure when the multiperforated grain goes into slivers, as it does when about 85 per cent burned. There may be something not interpreted correctly here, for it is plain that at the instant of formation of the slivers, their total surface is that of the grain, and though there are continuous elementary decreases in their total surface thereafter there is no sudden drop. In short, there must be an angle or hump in the pressure curve at the corresponding point of travel of the projectile, and the curve must suddenly become very steep comparatively, but there can be no theoretical break in the continuity of the curve.

Sarrau is mentioned by name once or twice in this book in a casual way in connection with some point. He is not mentioned in the history of those who contributed to the subject, and there is nothing whatever to indicate that he pointed the way. Notwithstanding the contributions of Noble and Abel, the author as stated before is not following their methods. But he is following Sarrau's general method (with a certain heresy) and is basing his results on Sarrau's premises. The French writers, and many other Continental writers on this subject, think in integral equations, and Sarrau, it is believed, got diverted too far along this same line. This is avoided here by substituting a letter for a definite key integral when found and then going ahead on that as a basis. And time is eliminated by using certain dimensions which Sarrau omitted to do.

Taken all in all, from a strictly ballistic point of view, this book is as good for practical results as any other book on the subject in circulation at this date, and probably better.

Certainly everything is presented in as simple a manner as it can be presented, the author's notation is excellent, and the fact that the tables have been calculated by him, or under his supervision, carries with it a conviction, in view of his general reputation in other fields and with other ballistics, that they are strictly accurate. There is no objection ballistically to using the ratio 1/3 for the specific heats of the powder gas. Noble and Abel's results in fact indicate 1 1/3 this value approximately for the gases of ordinary gun powder when exploded in a closed vessel. The practical assumption of a co-volume (non-gaseous volume) which does not exist with smokeless powders, and only in part with the ordinary powders moreover necessitates in a working ballistic formula a smaller ratio than the true one, whatever it may be.

The apparent inconsistency of applying these formulæ to smokeless as well as ordinary powders seems to require some explanation and with a view to giving a clear insight into what actually transpires, attention is invited to the following, which involves some repetition of what precedes:

(a) In deducing the original formulæ, the powder gas was assumed a perfect gas with the non-gaseous residue equal in volume to the solid volume of the powder grains and the gas was assumed to expand without

gain or loss of heat. The ratio of the specific heats of the gas was denoted by n, and for these conditions

n equals 1.4.

(b) Now the residue at the instant of its formation is together with the gas at the temperature of combustion of the powder, and as the gas expands with a lowering of its temperature consequent on the work done, it is possible, the hot residue being presumably finely distributed throughout the gas, that this residue imparts to the cooling gas more heat than the gas imparts to the gun. To meet this condition in the formulæ, there being no other compensation, it becomes obvious on a little consideration that

n must be assumed as less than 1.4.

(c) But if on the other hand, the residue or other source of heat does not impart as much heat to the expanding gas as the latter imparts to the gun and we do not otherwise compensate in the formulæ, we are compelled to assume that

n is greater than 1.4.

(d) And if everything remains as stated in (a) except that the volume of the residue is less than the solid volume of the powder, and we attempt to compensate for this error by changing the value of n as involved in the tabular functions of the formulæ, we will have to decrease it, or make

n less than 1.4.

There are other things that might be considered, such as whether the gas is perfect, etc., and it is plain that the subject is not exhausted with these equalities and inequalities, but they suffice for present consideration. Let us note the application of them as they stand. For ordinary powders the question arises at once does (b) or does (c) prevail? On account of the great difference in temperature of gun and gas as well as the loss of heat by friction of the gas on the gun, it is quite likely that of these two (c) has the predominant effect. There is, however, no doubt as to the last or (d) and that (d) more than overcomes the predominating effect of (c) over (b) is indicated by the better results when a value 1 1/3 is substituted for 1.4, as n in the formulæ (assuming of course that a long series of tests at the Artillery School, and elsewhere, has demonstrated this superiority with ordinary powders).

Let us now consider smokeless powders. There is no residue, so it is evident at once that (c) and (d) stand alone and in full value, and have opposite influences. And any doubt as to which influence is the greater is set at rest by the results shown in this book, as well as by a consideration of what these influences are. Though (c) has been treated very casually at times, some late results with explosions, even detonations, in a closed volume indicate that the cooling effect of the envelope should always be considered with the lower densities of loading, and, therefore, though in a lesser degree, with the higher densities of loading. The temperature of the smokeless powder gas is higher than that of the ordinary powder gas, and consequently more heat is presumably lost to the gun; and there is no com-

pensating source of heat. So though the decrease of n due to (d) must be considerable, the great increase due to (c) apparently serves to retain n in the vicinity of 1 1/3 for smokeless powders. Those who are going to develop this subject further, and it is worthy of a good endeavor will therefore do well to study this book very carefully.

It is possible that the author endeavored to keep out certain considerations, of a minor ballistic character, in order that the practical working should not be clouded. Thus, it is certainly simpler when two parameters are to be obtained from two measured quantities, such as the maximum pressure and the muzzle velocity of a gun, to employ these measured quantities as they are without considering that one of them is subject to a certain reduction.

It has then certain limitations to the field of practical ballistics. As a matter of fact, and nothing is more easy of demonstration than this (notwithstanding certain fumbling by late writers), the maximum pressure on the breech block exceeds that on the projectile (not to speak of effective pressures) in present guns by as much as one-tenth or more, and it is probable that if the ratio of specific heats of the gas were taken as 1 1/4 (the tables are easily calculated) the results, so far as the actual velocities and pressure are concerned, would be even more accurate than they are, especially with smokeless powders. The fact that it is necessary to assume a co-volume, which cannot exist in full with any powder, to account for the pressure in a closed vessel, where the assumption is made that Mariotte's law is applicable, does not constitute a reason for such an assumption in other cases where Mariotte's law as such can play no part. In fact, it is very doubtful if Mariotte's law alone should ever be applied strictly in the case of any explosion for the reason that it thus becomes logically necessary to drop consideration of the pressure due to the sensible motion of the explosive products, a pressure comparable with that due to their molecular motion. The pressure in short that is shown by a gauge for an explosion in a closed vessel is probably a function of the form of the powder grain (in a minor degree) and rate of burning in addition to other quantities just as it is in a gun, and one can only hope that Colonel Ingalls or some one else who has the time, ability and energy will take up this subject again in the future and develop it along strictly theoretical lines on some such basis. It is important not only for guns, but for all internal combustion engines. The gun is simply a very perfect engine and should be made to assist in clearing up the apparent vagaries in the present thermo-dynamics of gases. And the principles involved are of more importance generally speaking than the immediate results.

J. H. GLENNON, Captain, U. S. Navy.

LIST OF PRIZE ESSAYS.

1879.

Naval Education. Prize Essay, 1879. By Lieut.-Com. A. D. Brown, U. S. N.

NAVAL EDUCATION. First Honorable Mention. By Lieut.-Com. C. F. Goodrich, U. S. N.

NAVAL EDUCATION. Second Honorable Mention. By Commander A. T. Mahan, U. S. N.

1880.

"The Naval Policy of the United States." Prize Essay, 1880. By Lieutenant Charles Belknap, U. S. N.

1881.

The Type of (I) Armored Vessel, (II) Cruiser best suited to the Present Needs of the United States. Prize Essay, 1881. By Lieutenant E. W. Very, U. S. N.

SECOND PRIZE ESSAY, 1881. By Lieutenant Seaton Schroeder, U. S. N.

1882.

Our Merchant Marine: The Causes of its Decline and the Means to be taken for its Revival. "Nil clarius aquis." Prize Essay, 1882. By Lieutenant J. D. J. Kelley, U. S. N.

"MAIS IL FAUT CULTIVER NOTRE JARDIN." Honorable Mention. By Master C. G. Calkins, U. S. N.

"SPERO MELIORA." Honorable Mention. By Lieut.-Com. F. E. Chadwick, U. S. N.

"CAUSA LATET: VIS EST NOTISSIMA." Honorable Mention. By Lieutenant R. Wainwright, U. S. N.

1883.

How may the Sphere of Usefulness of Naval Officers be extended in Time of Peace with Advantage to the Country and the Naval Service? "Pour encourager les Autres." Prize Essay, 1883. By Lieutenant Carlos G. Calkins, U. S. N.

"SEMPER PARATUS." First Honorable Mention. By Commander N. H. Farquhar, U. S. N.

"CULIBET IN ARTE SUA CREDENDUM EST." Second Honorable Mention. By Captain A. P. Cooke, U. S. N.

1884.

The Reconstruction and Increase of the Navy. Prize Essay, 1884. By Ensign W. I. Chambers, U. S. N.

1885.

Inducements for Retaining Trained Seamen in the Navy, and Best System of Rewards for Long and Faithful Service. Prize Essay, 1885. By Commander N. H. Farquhar, U. S. N.

1886.

What Changes in Organization and Drill are Necessary to Sail and Fight Effectively Our Warships of Latest Type? "Scire quod nescias." Prize Essay, 1886. By Lieutenant Carlos G. Calkins, U. S. N.

THE RESULT OF ALL NAVAL ADMINISTRATION AND EFFORTS FINDS ITS EXPRESSION IN GOOD ORGANIZATION AND THOROUGH DRILL ON BOARD OF SUITABLE SHIPS. Honorable Mention. By Ensign W. L. Rodgers, U. S. N.

1887.

The Naval Brigade: its Organization, Equipment and Tactics. "In hoc signo vinces." Prize Essay, 1887. By Lieutenant C. T. Hutchins.

1888.

Torpedoes. Prize Essay, 1888. By Lieut.-Com. W. W. Reisinger, U. S. N.

1891.

The Enlistment, Training and Organization of Crews for our Ships of War. Prize Essay, 1891. By Ensign A. P. Niblack, U. S. N.

DISPOSITION AND EMPLOYMENT OF THE FLEET: SHIP AND SQUADRON DRILL. Honorable Mention, 1891. By Lieutenant R. C. Smith, U. S. N.

1892.

Torpedo-boats: their Organization and Conduct. Prize Essay, 1892. By Wm. Laird Clowes.

1894.

The U.S.S. Vesuvius, with Special Reference to her Pneumatic Battery. Prize Essay, 1894. By Lieut.-Com. Seaton Schroeder, U. S. N.

NAVAL REFORM. Honorable Mention, 1894. By Passed Assistant Engineer F. M. Bennett, U. S. N.

1895.

Tactical Problems in Naval Warfare. Prize Essay, 1895. By Lieut.-Com. Richard Wainwright, U. S. N.

A SUMMARY OF THE SITUATION AND OUTLOOK IN EUROPE. An Introduction to the Study of Coming War. Honorable Mention, 1895. By Richmond Pearson Hobson, Assistant Naval Constructor, U. S. N.

SUGGESTIONS FOR INCREASING THE EFFICIENCY OF OUR NEW SHIPS. Honorable Mention, 1895. By Naval Constructor Wm. J. Baxter, U. S. N.

THE BATTLE OF THE YALU. Honorable Mention, 1895. By Ensign Frank Marble, U. S. N.

1896.

The Tactics of Ships in the Line of Battle. Prize Essay, 1896. By Lieutenant A. P. Niblack, U. S. N.

THE ORGANIZATION, TRAINING AND DISCIPLINE OF THE NAVY PERSONNEL AS VIEWED FROM THE SHIP. Honorable Mention, 1896. By Lieutenant Wm. F. Fullam, U. S. N.

NAVAL APPRENTICES, INDUCEMENTS, ENLISTING AND TRAINING. The Seaman Branch of the Navy. Honorable Mention, 1896. By Ensign Ryland D. Tisdale, U. S. N.

THE COMPOSITION OF THE FLEET. Honorable Mention, 1896. By Lieutenant John M. Ellicott, U. S. N.

1897.

Torpedo-boat Policy. Prize Essay, 1897. By Lieutenant R. C. Smith, U. S. N.

A PROPOSED UNIFORM COURSE OF INSTRUCTION FOR THE NAVAL MILITIA. Honorable Mention, 1897. By H. G. Dohrman, Associate Member, U. S. N. I.

TORPEDOES IN EXERCISE AND BATTLE. Honorable Mention, 1897. By Lieutenant J. M. Ellicott, U. S. N.

1898.

Esprit de Corps: A Tract for the Times. Prize Essay, 1898. By Captain Caspar Frederick Goodrich, U. S. N.

OUR NAVAL POWER. Honorable Mention, 1898. By Lieut.-Com. Richard Wainwright, U. S. N.

TARGET PRACTICE AND THE TRAINING OF GUN CAPTAINS. Honorable Mention, 1898. By Ensign R. H. Jackson, U. S. N.

1900.

Torpedo Craft: Types and Employment. Prize Essay, 1900. By Lieutenant R. H. Jackson, U. S. N.

THE AUTOMOBILE TORPEDO AND ITS USES. Honorable Mention, 1900. By Lieutenant L. H. Chandler, U. S. N.

1901.

Naval Administration and Organization. Prize Essay, 1901. By Lieutenant John Hood, U. S. N.

1903.

Gunnery in Our Navy. The Causes of its Inferiority and Their Remedies. Prize Essay, 1903. By Professor Philip R. Alger, U. S. N.

A NAVAL TRAINING POLICY AND SYSTEM. Honorable Mention, 1903. By Lieutenant James H. Reid, U. S. N.

SYSTEMATIC TRAINING OF THE ENLISTED PERSONNEL OF THE NAVY. Honorable Mention, 1903. By Lieutenant C. L. Hussey, U. S. N.

OUR TORPEDO-BOAT FLOTILLA. The Training Needed to Insure its Efficiency. Honorable Mention, 1903. By Lieutenant E. L. Beach, U. S. N.

1904.

The Fleet and Its Personnel. Prize Essay, 1904. By Lieutenant S. P. Fullinwider, U. S. N.

A PLEA FOR A HIGHER PHYSICAL, MORAL AND INTELLECTUAL STANDARD OF THE PERSONNEL FOR THE NAVY. Honorable Mention, 1904. By Medical Inspector Howard E. Ames, U. S. N.

1905.

American Naval Policy. Prize Essay, 1905. By Commander Bradley A. Fiske, U. S. N.

THE DEPARTMENT OF THE NAVY. Honorable Mention, 1905. By Rear-Admiral Stephen B. Luce, U. S. N.

1906.

Promotion by Selection. Prize Essay, 1906. By Commander Hawley O. Rittenhouse, U. S. N.

THE ELEMENTS OF FLEET TACTICS. First Honorable Mention, 1906. By Lieut.-Com. A. P. Niblack, U. S. N.

GLEANINGS FROM THE SEA OF JAPAN. Second Honorable Mention, 1906. By Captain Seaton Schroeder, U. S. N.

THE PURCHASE SYSTEM OF THE NAVY. Third Honorable Mention, 1906. By Pay Inspector J. A. Mudd, U. S. N.

1907.

Storekeeping at the Navy Yards. Prize Essay, 1907. By Pay Inspector John A. Mudd, U. S. N.

BATTLE REHEARSALS. A few thoughts on our next step in Fleet-Gunnery. First Honorable Mention, 1907. By Lieut.-Comdr. Yates Stirling, U. S. N.

THE NAVAL PROFESSION. Second Honorable Mention, 1907. By Commander Bradley A. Fiske, U. S. N.

1908.

A Few Hints to the Study of Naval Tactics. Prize Essay, 1908. By Lieutenant W. S. Pye, U. S. N.

THE MONEY FOR THE NAVY. First Honorable Mention, 1908. By Pay Inspector John A. Mudd, U. S. N.

THE NATION'S DEFENSE—THE OFFENSIVE FLEET. How Shall We Prepare It for Battle? Second Honorable Mention, 1908. By Lieut.-Commander Yates Stirling, U. S. N.

1909.

Some Ideas about Organization on Board Ship. Prize Essay, 1909. By Lieutenant Ernest J. King, U. S. N.

THE NAVY AND COAST DEFENCE. Honorable Mention, 1909. By Commodore W. H. Beehler, U. S. N.

THE REORGANIZATION OF THE NAVAL ESTABLISHMENT. Honorable Mention, 1909. By Pay Inspector J. A. Mudd, U. S. N.

A PLEA FOR PHYSICAL TRAINING IN THE NAVY. Honorable Mention, 1909. By Commander A. P. Niblack, U. S. N.

1910.

The Merchant Marine and the Navy. Prize Essay, 1910. By Naval Constructor T. G. Roberts, U. S. N.

THE NAVAL STRATEGY OF THE RUSSO-JAPANESE WAR. Honorable Mention, 1910. By Lieutenant Lyman A. Cotten, U. S. N.

1911.

Navy Yard Economy. Prize Essay, 1911. By Paymaster Charles Conard, U. S. N.

NAVAL POWER. Honorable Mention, 1911. By Captain Bradley A. Fiske, U. S. N.

WANTED—FIRST AID. Honorable Mention, 1911. By Commander C. C. Marsh, U. S. N.

1912.

Naval Might. Prize Essay, 1912. By Lieutenant Ridgely Hunt, U. S. N. (retired).

INSPECTION DUTY AT THE NAVY YARDS. Honorable Mention, 1912. By Lieut.-Commander T. D. Parker, U. S. N.

SPECIAL NOTICE.

NAVAL INSTITUTE PRIZE ESSAY, 1913.

A prize of two hundred dollars, with a gold medal, and a life-membership in the Institute, is offered by the Naval Institute for the best essay presented on any subject pertaining to the naval profession, subject to the following rules:

1. The award for the prize shall be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors.

2. Each competitor to send his essay in a sealed envelope to the Secretary and Treasurer on or before January 1, 1913. The name of the writer shall not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary and Treasurer, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Board.

3. The successful essay to be published in the Proceedings of the Institute; and the essays of other competitors, receiving honorable mention, to be published also, at the discretion of the Board of Control; and no change shall be made in the text of any competitive essay, published in the Proceedings of the Institute, after it leaves the hands of the Board.

4. If, in the opinion of the Board of Control, the best essay presented is not of sufficient merit to be awarded the prize, it may receive "Honorable Mention" or such other distinction as the Board may decide.

5. In case one or more essays receive "Honorable Mention," the writer of the first of them in order of merit will receive seventy-five dollars and a life-membership in the Institute.

6. Any essay not having received honorable mention may be published also, at the discretion of the Board of Control, but only with the consent of the author.

7. The essay is limited to fifty (50) printed pages of the Proceedings of the Institute.

8. All essays submitted must be either typewritten or copied in a clear and legible hand.

9. In the event of the prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of the gold medal.

By direction of the Board of Control.

RALPH EARLE,
Lieut.-Commander, U. S. N., Secretary and Treasurer.

MEDAL PRESENTED TO WINNER PRIZE ESSAY CONTEST, 1912

NOTICE.

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It now enters upon its thirty-ninth year of existence, trusting as heretofore for its support to the officers and friends of the Navy. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute. by the contribution of papers and communications upon subjects of interest to the naval profession, as well as by personal support and influence.

On the subject of membership the Constitution reads as follows:

ARTICLE VII.

Sec. 1. The Institute shall consist of regular, life, honorary, and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fees to the Secretary and Treasurer. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control, and a vote equal to one-half the number of regular and life members, given by proxy or presence, shall be cast, a majority electing.

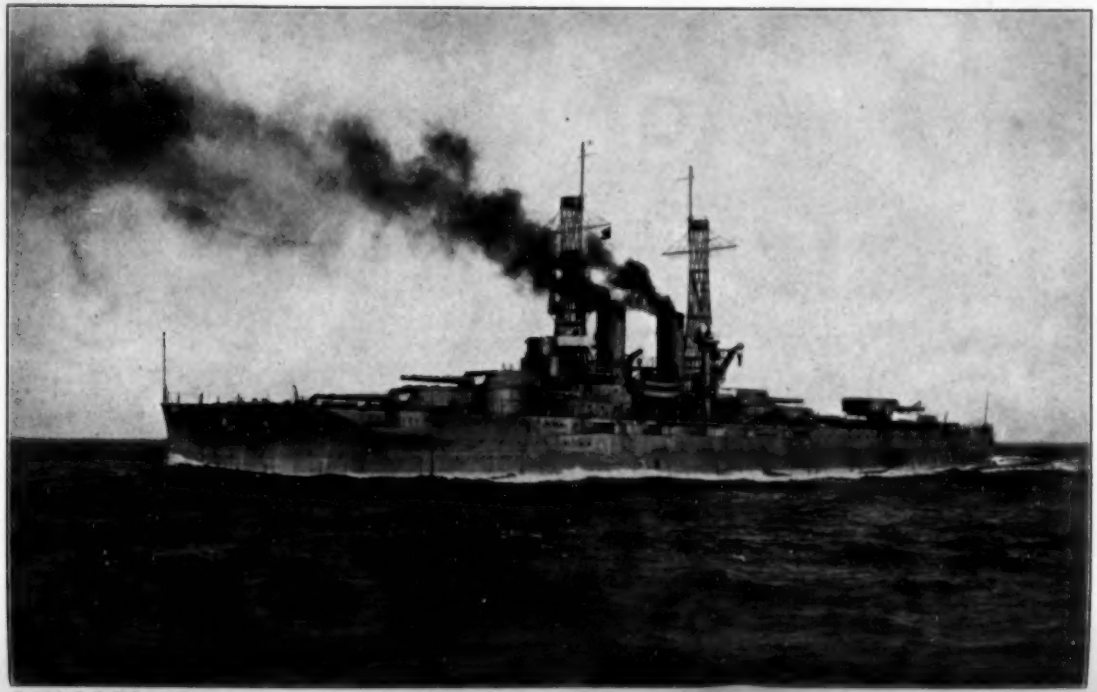
Sec. 5. Associate members shall be elected from Officers of the Army, Revenue Cutter Service, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: "Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control, and, if their report be favorable, the Secretary and Treasurer shall make known the result at the next meeting of the Institute, and a vote shall then be taken, a majority of votes cast by members present electing."

The Proceedings are published quarterly and anyone may subscribe for them. The annual subscription is $3.00; single copies, 75 cents. Annual dues for members and associate members, $2.00. Fee for life membership, $30.00.

All letters should be addressed U. S. Naval Institute, Annapolis, Md., and all checks, drafts, and money orders should be made payable to the same.



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